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"CONSERVATION OF WILD LIFE THROUGH EDUCATION"

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A PROGRESS REPORT ON THE TUNA INVESTIGATIONS[1]

By H. C. Godsil

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The California State Fisheries Laboratory recently issued Fish Bulletin No. 70, entitled "A Preliminary Population Study of the Yellowfin Tuna and Albacore." This is necessarily a technical report, on one phase of the tuna investigations. The purpose of the present article is to review the results of the study, and explain to the public its relation to, and importance in the over-all tuna program.

The fundamental goal of this laboratory is to find out for each commercial species the greatest tonnage that can be taken annually without reducing the stock to the point where it can no longer yield that maximum in succeeding years. The problem consists in balancing what is taken out of a fishery each year against what is added by the annual spawning and normal seasonal growth. Before this can be done, however, some preliminary questions must be answered. Of these some of the more important are:

1. What is the geographical range of the species?
2. Is the species fished over its entire distributional range, or are fishing operations confined to only that portion of the range within reach of a local fleet?
3. Finally, does the species consist of a single, intermingling population over its entire extent, or is the stock composed of distinct units, which normally maintain their identity within a limited geographical area by reason of the fact that the various geographic units do not normally intermingle?

The significance of these questions becomes apparent upon a little thought, and a simple analogy helps to visualize the problem. One might liken a stock of fish to a reservoir. If the entire watershed drains via a single local stream into a single reservoir which is being tapped for all that can be taken from it, the problem then becomes one of balancing the yield against the quantity flowing in, maintaining at the same time a minimum or proper level within the reservoir as a reserve and to insure efficient operation of the system. This corresponds to total exploitation of a species over its entire distributional range.

If one modifies the analogy and now assumes that the reservoir is supplied by the one local stream and in addition by an unknown and perhaps larger volume of water coming from some distant or obscure source, then it follows that the quantity flowing from the reservoir will be in excess of that contributed by the local stream. This corresponds to a fishery which is drawing upon the fringes or at least only a portion of the total stock, and which in consequence possesses an unexploited reserve

[1] Submitted for publication May, 1948.

to replenish the take. Such a fishery can often be more intensively developed.

If finally one supposes that the entire watershed drains into a number of separate reservoirs, each with a distinct supply, then each reservoir must be managed as a separate unit, with the take from a given reservoir balanced against its own restricted supply. While it is still true that the total overflow depends upon the total supply from the entire drainage basin, it is nevertheless necessary, for maximum utilization and the efficient operation of the entire system, to consider each reservoir as a distinct unit. The take from each must be proportional to its particular supply to maintain it at a proper level. Basically this is comparable to a fishery which exploits a number of distinct and nonintermingling populations. This analogy illustrates some of the difficulties in fisheries problems and the importance of the foregoing questions.

Coming back to the tunas, a previous study [1] showed that it was not possible to distinguish individual yellowfin tuna from Japan, from Hawaii, from Peru or from our own fishing area. All are similar, and must, therefore, be regarded as of the same species. Likewise specimens of albacore from Japan, Hawaii and the North American coastline cannot be told apart. Therefore, insofar as these two species are concerned, the potential supply extends across the Pacific. The next question to answer is: Does the Pacific stock of each species consist of a single reservoir, with the fish migrating extensively and intermingling throughout, or is the stock made up of separate populations which remain distinct, each confined to some particular oceanic region? In the latter event, for example, our fishery for yellowfin tuna might be dependent upon one or more populations confined to the eastern Pacific. It would, therefore, be independent of the Japanese fishery, which would depend in turn upon a population or populations confined to the western Pacific. If on the contrary the stock of yellowfin throughout the Pacific consists of a single intermingling population, then this single reservoir is being tapped from at least three points, Hawaii, Japan and California, of which the largest stream flows to Japan. Under these conditions attempted management of the California fishery would be futile unless it could be coordinated with the over-all management of the entire reservoir. How is this question to be answered?

There are two practical alternatives. The first is to mark or tag fish in sufficient numbers to determine from the place of recapture the movements of fish and the extent of intermingling. This method was attempted in 1936 and 1937. Approximately 4,000 tuna, mostly yellowfin, were tagged on the gill-cover and released off this coast, but practically no recoveries were made. The failure of the program was in part due to the placement of the tag which was frequently torn from the gill-cover by the subsequent handling of the fish, and in part to the inadequacy of the numbers in relation to the extent of the fishery. The attempt to tag was temporarily discontinued because the necessary staff and facilities for an adequate tagging project were not available.

The second alternative is to make a detailed statistical study of a few selected characters from a relatively large number of specimens. This method is based upon the observed facts of biological variation. Thus the various species of tuna can be told apart by differences in a number of

[1] "A Systematic Study of the Pacific Tunas," California Division of Fish and Game, Fish Bulletin, No. 60.

characters. The liver of the yellowfin is quite different in appearance from that of the remaining tunas and identifies the species. The length of the pectoral fin likewise differs in the various species and serves as an identifying character. Although such characters are specific and are true of each member of the species they vary nevertheless within certain limits, just as the weight or stature of individuals in a human family or community varies around a certain average. Such variation about a group average is universally true throughout the plant and animal kingdom, and special methods have been developed to analyze this variation. Furthermore it has been found that environmental conditions during development affect to a limited degree the average development of any character. Thus the average stature of children raised in some western states is appreciably higher than the national average. Analogous facts apply to fish populations and can be used as measures of degree of relationship and intermingling of fish from different regions. Thus if fish are spawned and reared in different areas under slightly different environmental conditions, the average development of any physical character may differ appreciably in the two areas, and this becomes apparent upon statistical analysis. This was the method adopted in the population study of the tunas.

In the case of the yellowfin tuna six measurements were carefully made upon 1,911 specimens collected in nine regions within the total area exploited by the California tuna fleet. These regions include Clipperton Island, Cocos Island, the Galapagos Islands and six regions along the coastline extending from Lower California to Panama. Of these six measurements one, the body length (or the length of the fish measured from the tip of the upper jaw to the fork of the tail), was used as a basis of comparison and the remaining five were related to the body length, yielding five comparative characters. By way of illustration the relationship existing between the length of the head and the body length of each fish was treated as one character, and the change in this relationship with increasing size of individual fish was accurately determined for each separate sample. The relationships thus established for each sample were then compared to see whether the average for a given region differed appreciably and consistently from those from other fishing areas. This analysis was duplicated for each of the five pairs of measurements, constituting the five independent characters used, and it was discovered that the averages from all these samples were sufficiently constant so that the average for any subsequent sample taken from this population could be predicted within narrow limits. Thus the population averages for these characters were established to serve as identifying marks for the eastern Pacific yellowfin. With this knowledge the Japanese, Hawaiian and Peruvian yellowfin were then treated identically, and the character averages thus obtained for each sample were compared with the corresponding value for the American population.

Basically, the albacore was treated in the same way. Differences in the nature of the fishery suggested minor differences in the plan of the study. Fourteen separate characters, instead of five as in the yellowfin, were used in this comparison, and both the number of samples and the number of fish in the local samples were much smaller. In both studies it proved extremely difficult to obtain fish from overseas, and only 5 or 10

specimens of each species were obtained from Japan and Hawaii. Furthermore with facilities at hand, it took about two years to assemble from the various local fishing grounds the necessary collection of yellowfin tuna. With the war intervening it was decided to compile the results on the basis of the material already collected, without waiting for additional samples. The following results must therefore be regarded as preliminary conclusions which will be checked as soon as additional material can be obtained from overseas.

The stock of yellowfin tuna within the area now fished by the California fleet appears to consist of a single intermingling population. It is not possible at this time to identify any sample with a particular geographic origin or detect any association between a particular fishing ground and the average value of any character measured from fish taken on that fishing ground. It appears more probable that there is a free interchange of fish from all the several grounds.

If upon this assumption the population values for any character are established and accepted as identifying marks of this population, then the corresponding Japanese and Hawaiian values differ from these to an extent many times that of any individual local sample. Both the Japanese and Hawaiian yellowfin appear to be of a distinct and separate population. The Japanese fish differ most from ours while the Hawaiian yellowfin are intermediate in position.

The yellowfin from Peru are in general similar to our local fish but differ sufficiently in one character to be regarded as distinct. In this comparison the results are somewhat confusing, and it will take further study of more adequate samples to reach an ultimate conclusion. Until such time, one must temporarily assume that the Peruvian yellowfin are of a separate population and do not contribute to the local stock.

Of the 14 characters investigated in the albacore the Japanese fish differed significantly (in a statistical sense) from the local in 10. The extent of these differences varied considerably. A study of the material reveals that the essential difference, explaining the majority of measurements, consists of the fact that in the Japanese albacore the head and tail regions of the body are proportionately shorter than in local albacore. The abdominal or central portion of the body is relatively longer in the Japanese fish. Also the eye is larger, the pectoral fin longer and the height of the first dorsal fin is greater in the Japanese fish than in the local specimens. These differences strongly suggest that the Japanese and local populations are quite distinct and nonintermingling.

Only three Hawaiian specimens were obtained and all were considerably larger than any of the local or Japanese fish. The material was therefore not directly comparable and it is dangerous to draw conclusions. However, the results indicate that the Hawaiian fish are more similar or closely related to the Japanese albacore than to our local fish.

In evaluating the above conclusions the reader must remember that positive proof of a statement is almost impossible to obtain. Throughout the scientific field results are assessed in terms of probability. When a relationship between cause and effect is suspected, assumptions are made regarding this relationship and deductions, or predictions, are based on these assumptions. The extent that these deductions, or predictions, materialize as the result of laboratory experiment or experience determines the probability of the correctness of the assumptions. When a pre-

dicted result occurs in every case this probability amounts to certainty, even though a rigid formal proof is not possible.

In the present case the foregoing conclusions resulting from the study of the available samples afford the most logical assumptions upon which to base both management and investigations. If these assumptions are correct then further samples (when they can be obtained) from Japan and the Hawaiian Islands should yield values for each character approximating those deduced from the present study. This in reality will constitute relative proof of the correctness of the assumptions.

In conclusion it will be profitable to weigh the practical significance of the results. Both yellowfin tuna and albacore are to be found across the width of the Pacific. But it appears that the stock now exploited on this coast consists of a separate and distinct reservoir dependent upon itself for replenishment and receiving no recruitment from the western Pacific. In other words, both the albacore and the yellowfin are confined to a relatively local reservoir in the eastern portion of the Pacific. The next problem therefore is to balance the take of each species against the annual replacement rate.

Considering the yellowfin first, this population is now exploited over its entire distributional area. From studies now nearing completion it appears that the annual catch has reached the maximum which can be profitably and consistently taken. If the pack of this species is to be materially increased it will be necessary to tap new reservoirs elsewhere in the Pacific. Continued increases in the intensity of the fishery in the present areas will eventually result in hardship to all and in possible disaster.

The albacore presents a different problem. At this time the fishery is seasonal with almost 90 percent of the annual catch being landed in the three-month interval, July to September. If this rate of exploitation could be continued throughout the year the annual catch should at least be trebled. But the fish are not normally available in the balance of the year, and at present no one knows their whereabouts. Furthermore, we do not know, even in the fishing season, what portion of the stock we are exploiting. Until these two questions are answered one cannot make a rational balance between annual catch and annual replacement. Hence, what is needed is exploratory work to answer these two questions: (1) Where are the albacore from October to June, and (2) what portion of the stock are we exploiting in the fishing season?

The present tuna investigative program of the Bureau of Marine Fisheries is based upon the foregoing presentation of facts and assumptions, and upon the questions discussed. For the yellowfin tuna our efforts are concentrated upon a study of the proper rate of exploitation. This goal is being sought through a careful analysis of the relationship between the annual catch of past years and the tonnage of the total fleet engaged in making that catch.

In regard to the albacore, exploratory trips are now under way. Using conventional trolling gear for surface fishing and drift gillnets to explore greater depths, the research vessel, "N. B. Scofield," will, as opportunity offers, investigate the northeastern Pacific, in the area bounded on the east by the North American coastline and on the west by the longitude of the Hawaiian Islands. Somewhere within this area, it is suspected, is the home of the albacore, and sooner or later this will be found, with the necessary clues as to their migrations and abundance.

A NEW TYPE OF FIELD KEY APPLIED TO THE FLATFISHES OF CALIFORNIA [1]

By Howard McCully
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When the time required to make identifications by use of a key is of irksome length, the user is apt to make consciously or subconsciously contractions in his method of operation. Some of these short cuts may lead to error; others may be legitimate devices to increase the efficiency of the work. The key here presented is the result of a systematic study of such shortened method.

It is believed that some of the features of this key may find wide use. This method of constructing a key can be turned to account in any survey where large numbers of specimens must be classified into more groups than can be easily memorized. When the number of classes exceeds 30 or 40, the methods should be combined with the usual form of key to reduce the number of decisions which will be required for species far down in the key.

Seven impediments to the quick use of the usual key were recognized and have been dealt with by the means listed below:

1. Brevity has been achieved by holding the number of entries to that of the number of species.
2. Irresolute workers may have been helped by making it impossible to consult more than one line for each decision.
3. To prevent straying, each decision follows its predecessor in sequence.
4. The correct appraisal of each specimen is speeded by avoiding, as much as possible, the counting of minute structures and the use of inaccessible characters.
5. The name of the part to be examined first is placed at the beginning of each description so that the specimen can be oriented while the descriptive phrase is being read.
6. To avoid the rereading of the same phrase on successive lines, ditto marks have been used.
7. The repetition normal to dichotomous keys has been avoided.

This key was successfully used by the writer in 1940 to identify all the flatfishes taken in a survey off the coast of Southern California and, after revision, was verified with the help of Miss Janet Haig and members of Dr. George S. Myers' class in vertebrate classification at Stanford University.

The time required to make reliable identifications in the most marked limitation of the ordinary dichotomous key when used in the field. In the experience of the author the most difficult conditions were encountered aboard fishery survey vessels when the sexing and measuring of the fish must often be deferred until the ship's work is done. If fish are to be

[1] Submitted for publication August, 1948.

tagged, no more than a few seconds will ever be available for the identification of each specimen. This leaves the biologist to identify the fish under a severe time handicap.

Because this key has been made primarily for fresh specimens of the sizes which can be taken with 1½-inch mesh trawl nets, it has been necessary to discard certain characters sometimes used to separate adult flatfishes of this group. When the key is to be used with small specimens, some of the characters given must be interpreted on the basis of what they will become after further growth. Some of these characters are discussed below:

Maxillary: The extent to which the maxillary extends posteriorly in relation to the eye has been used to separate some of the species. This relationship varies with the size of the specimen in most such species; the angle of the maxillary to the axis of the head decreases with the increase of length in the fish. Therefore, in very small specimens, the posterior end of the maxillary may not reach as far back as has been indicated in this and other keys.

Platichthys stellatus: The character given is not always preserved in alcoholic specimens.

Citharichthys sordidus and *C. stigmaeus:* The difference used here will separate very small specimens where the traditional characters of the inter-orbital ridge lead to misidentification.

USE OF THE KEY

The key should be entered at line "1" and the specimen compared with the description printed there and so on with each line in turn until one is found which describes the fish. The specimen will be of the species named on the first line which fits the characters of the fish.

Unless otherwise specified, all the characters given refer to those of the ocular side.

The measures and proportions given in the key unless qualified mean "equal to or more than," "at least," or "at least to the."

The following are the abbreviations used in the key.

A	anal fin	LL	lateral line
C	caudal fin	Max	maxillary
D	dorsal fin	SL	standard length
P	pectoral fin	TL	total length
V	ventral fin		

The abbreviations of the generic and specific names printed with this key are the official abbreviations of the Bureau of Marine Fisheries. These two and three letter contractions are sufficient to separate all of our species of flatfish and have been in use for many years.

For field use this key can be typed on one side of one sheet of paper and glued to a sheet of millboard and waterproofed. It is suggested that the identifications will be made more quickly if the scientific and common names are omitted. The key can then be hung upon a nail near the measuring board where it can be referred to in its entirety without touching it.

A KEY TO THE FLATFISHES OF CALIFORNIA

1. No P	A.b.	*Achirus barnharti*	----------
2. D & A joined to C	S.a.	*Symphurus atricaudus*	Tongue sole
3. Max runs back of eye; LL has no high arch	A.s.	*Atheresthes stomias*	Arrowtooth sole
4. " " " " " ; interocular ridge high	H.s.	*Hippoglossina stomata*	Bigmouth sole
5. " " " " "	P.c.	*Paralichthys californicus*	California halibut
6. LL has high arch; depth about 3 in SL	H.st.	*Hippoglossus stenolepis*	Pacific halibut
7. " " " " ; head much longer than P	L.b.	*Lepidopsetta bilineata*	Broadfin sole
8. " " " "	X.l.	*Xystreurys liolepis*	Fantail sole
9. P longer than head; center of eye back of max	G.z.	*Glyptocephalus zachirus*	Rex sole
10. " " " "	C.x.	*Citharichthys xanthostigma*	Sanddab
11. Gill opening not above P; C 2 in head	E.b.	*Embassichthys bathybius*	----------
12. " " " " "	M.p.	*Microstomus pacificus*	Dover sole
13. D & A striped in black and yellow	P.s.	*Platichthys stellatus*	Starry flounder
14. First D rays 1/2 free	P.m.	*Psettichthys melanostictus*	Sand sole
15. Origin of D near corner of mouth	P.d.	*Pleuronichthys decurrens*	Curlfin turbot
16. Snout overhung by spine	P.v.	" *verticalis*	Sharpridge turbot
17. Interocular has 2 blunt spines at front	P.r.	" *ritteri*	Spotted turbot
18. First 5 D rays on blind side	P.co.	" *coenosus*	C-O turbot
19. Depth about 2 in TL	H.g.	*Hypsopsetta guttulata*	Diamond turbot
20. LL dorsal branch about equal to orbit	I.iy.	*Inopsetta ischyra*	----------
21. LL dorsal branch long; scales rough	I.i.	*Isopsetta isolepis*	Scaly-fin sole
22. " " " "	P.v.	*Parophrys vetulus*	English sole
23. V on belly ridge; lower eye longer than snout	C.s.	*Citharichthys sordidus*	Sanddab
24. " " " "	C.st.	*Citharichthys stigmaeus*	Sanddab
25. About 20 scale rows above LL	L.e.	*Lyopsetta exilis*	Slender sole
26. About 30 " " " "	E.j.	*Eopsetta jordani*	Petrale sole

AGE AND LENGTH COMPOSITION OF THE SARDINE CATCH OFF THE PACIFIC COAST OF THE UNITED STATES AND CANADA IN 1947-48[1]

By Kenneth H. Mosher, Frances E. Felin, United States Fish and Wild Life Service, and Julius B. Phillips, California Division of Fish and Game

This is a second report on age and length composition of the sardine (*Sardinops caerulea*) catch off the Pacific Coast of the United States and Canada and covers the 1947-48 season. The first report (Felin and Phillips, 1948) covered the period 1941-42 through 1946-47.

Beginning with the 1941-42 season in California, a comprehensive program for scale collecting and age reading was undertaken cooperatively by the U. S. Fish and Wild Life Service and the California Division of Fish and Game. The Fisheries Research Board of Canada, the Washington State Department of Fisheries and the Fish Commission of Oregon contributed collections of scales from sardines in northern waters. These were included in the age-reading project. The results of determinations of age for the 1947-48 season are presented in tabular form without interpretation. Estimates of age from scales were made by the following biologists: Kenneth H. Mosher and Frances E. Felin of the U. S. Fish and Wild Life Service; J. B. Phillips and Anita Daugherty of the California Division of Fish and Game.

The cooperative nature of the work was such that many other persons of the various agencies were involved, for example, those sampling the catch in all ports, mounting scale samples, processing and tabulating the data which remain on file in the Fish and Wild Life Laboratory at Stanford University. The helpful cooperation of all these persons is gratefully acknowledged.

We also wish to thank Frances N. Clark of the California Division of Fish and Game, and John L. Hart of the Fisheries Research Board of Canada for their calculations of numbers of fish in the catch. Their helpful criticism as well as that of O. E. Sette of the Fish and Wild Life Service is also appreciated.

In addition to the regular commercial catch, the small interseasonal fishery at Monterey in 1947 was also sampled. This interseason extended from the close of the regular 1946-47 season on February 15 to the start of the 1947-48 season on August 1, 1947. The age and length composition, and numbers of fish caught at Monterey during this period are presented in separate tables (1-3). No data on the rather inconsiderable interseason for other California ports were obtained.

Methods of sampling the catch and determination of ages were continued in the same manner as formerly reported (Felin and Phillips, 1948).

Tables 4-10 give age and length composition for different areas (Fig. 1) along the coast in British Columbia, Washington and Oregon. Tables 11-17 show, similarly, the same data for California by ports,

[1] Submitted for publication September, 1948.

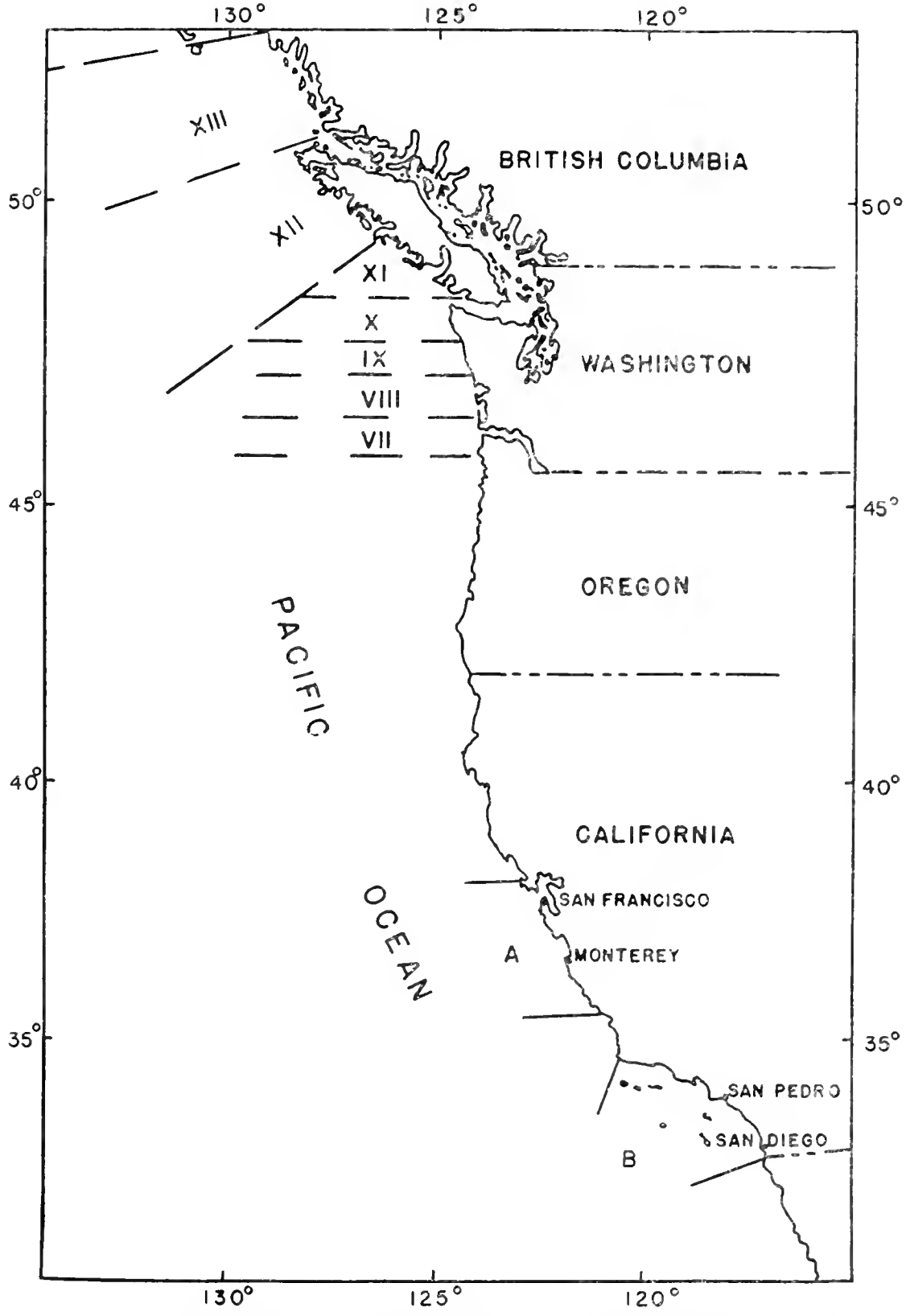

FIGURE 1. Sardine fishing areas. VII-XIII, areas in the Pacific Northwest fishery. (Areas IV-VI also were fished in 1947-48 and are of the same magnitude as VII-IX.) A, San Francisco-Monterey fishing grounds. B, Southern California fishing grounds.

TABLE 1

Length Composition of All Year-classes for Monterey 1947 Interseason

Length mm.	Year-classes																					Total		
	1946			1945			1944			1943			1942			1941			1940			1939			1938					
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
102	2	1	3																									2	1	3
104	2		2																									2		2
106	1		1																									1		1
108	1	1	2																									1	1	2
110	1		1																									1		1
112		2	2																										2	2
114	1	1	2																									1	1	2
116	1	1	2																									1	1	2
118	1	1	2																									1	1	2
120	2	1	3																									2	1	3
122	3		3																									3		3
124	4	2	6																									4	2	6
126	3	7	10																									3	7	10
128	4	4	8																									4	4	8
130	2	2	4																									2	2	4
132	5	3	8																									5	3	8
134	4	4	8																									4	4	8
136	4	3	7																									4	3	7
138	6	5	11																									6	5	11
140	6	2	8																									6	2	8
142	11	4	15																									11	4	15
144	7	8	15																									7	8	15
146	6	17	23																									6	17	23
148	9	7	16																									9	7	16
150	10	11	21																									10	11	21
152	10	5	15																									10	5	15
154	17	17	34																									17	17	34
156	8	10	18																									8	10	18
158	9	8	17	1		1																						10	8	18
160	6	12	18		1	1																						6	13	19
162	5	4	9																									5	4	9
164	9	9	18																									9	9	18
166	10	8	18																									10	8	18
168	11	14	25																									11	14	25
170	12	13	25		1	1																						12	14	26
172	4	12	16	3	1	4																						7	13	20
174	14	8	22																									14	8	22
176	5	12	17	2	1	3																						7	13	20
178	10	10	20	1	1	2																						11	11	22
180	9	7	16	3	2	5																						12	9	21
182	7	5	12	6	1	7																						13	6	19
184	3	2	5	1		1																						4	2	6
186	2	3	5		2	2				1	1																	2	6	8
188	1	1	2	2		2																						3	1	4
190	1		1	1		1																						2		2
192				2	2	4																						2	2	4
194																														
196				4	1	5																						4	1	5
198				2		2																						2		2
200				2	3	5																						2	3	5
202							1	1	2																			1	1	2
204				3		3																						3		3
206				2	1	3	1	1	2																			3	2	5
208					2	2																							2	2
210	1		1	1	1	2	1		1																			3	1	4
212																														
214				3		3	1		1																			4		4
216					1	1		3	3																				4	4
218				2	1	3																						2	1	3

TABLE 1—Continued

Length Composition of All Year-classes for Monterey 1947 Interseason

Length mm.	Year-classes: 1946			1945			1944			1943			1942			1941			1940			1939			1938			Total		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
220				1	1	2																						1	1	2
222																														
224					1	1																							1	1
226					2	2	1		1																			1	2	3
228				1		1																						1		1
230																														
232					1	1	1		1				1		1													2	1	3
234								1	1	2	1	3																2	2	4
236					1	1				1		1																1	1	2
238					1	1		1	1	1		1	1	2	3													2	4	6
240											1	1																	1	1
242											1	1	1		1													1	1	2
244										2	1	3					1	1										2	2	4
246											1	1																	1	1
248														1	1		1	1											2	2
250																	1	1		2	2	1		1				1	3	4
252														1	1					2	2								3	3
254														1	1				1		1	1	1	2				2	2	4
256																1		1		1	1	1		1				2	1	3
258																2		2		2	2		1	1		1	1	2	4	6
260														1	1														1	1
262																				1	1		1	1					2	2
264																														
266																														
268																														
270																														
272																														
274																														
276																										1	1		1	1
Totals	250	247	497	43	29	72	6	7	13	6	6	12	3	6	9	3	3	6	1	8	9	3	3	6		2	2	315	311	626

together with the Pacific Northwest summary, and a summary for the entire coast. Table 18 gives age composition of the catch in terms of numbers of fish caught in each political subdivision of the Pacific Northwest and in each port in California. Number of fish, mean length, and standard error of the mean of the samples for each year-class in 1947-48 by region of catch are given in Table 19. Calendar dates for lunar months in the 1947 interseason and 1947-48 season are given in Table 20.

Reference

Felin, F. E., and J. B. Phillips

1948. Age and length composition of the sardine catch off the Pacific Coast of the United States and Canada, 1941-42 through 1946-47. Calif. Div. Fish and Game, Fish Bull. No. 69, 122 pp.

TABLE 2

Age (Year-class) Composition of the Sardine Catch for Monterey 1947 Interseason

(Numbers of fish are given in thousands, i.e., 000 omitted)

Lunar month	Catch		Number of fish by year-class								
	Tons	Number	1946	1945	1944	1943	1942	1941	1940	1939	1938
"February"	55	496	208	109	10	20	49	20	40	20	20
"March"	221	4,030	2,244	641	138	320	183	92	229	183	
"April"	131	3,689	3,541	148							
"May"	1,214	24,846	22,334	1,536	837	139					
"June"	932	14,427	13,417	866				144			
"July"	3,816	41,493	32,676	7,261	780	519		257			
Totals	6,369	88,981	74,420	10,561	1,765	998	232	513	269	203	20

TABLE 3

Number of Fish, Mean Length and Standard Error of the Mean for Each Year-class for Monterey 1947 Interseason

Year-Class	No.	M	S.E.	Year-Class	No.	M	S.E.
1946				1941			
Male	250	155	1.22	Male	3	257	.60
Female	247	157	1.10	Female	3	247	1.76
Totals	497	156	.82	Totals	6	252	2.38
1945				1940			
Male	43	193	2.40	Male	1	254	
Female	29	201	3.98	Female	8	255	1.55
Totals	72	196	2.18	Totals	9	255	1.38
1944				1939			
Male	6	215	5.21	Male	3	253	1.77
Female	7	218	5.04	Female	3	258	2.31
Totals	13	217	3.39	Totals	6	256	2.15
1943				1938			
Male	6	238	1.85	Male			
Female	6	232	9.34	Female	2	267	9.00
Totals	12	235	4.65	Totals	2	267	9.00
1942							
Male	3	237	2.85				
Female	6	248	3.62				
Totals	9	245	3.10				

TABLE 4

Length Composition of the 1946, 1945 and 1944 Year-classes by Areas in the Pacific Northwest in 1947

Area	1946 Year-class age 1			1945 Year-class age 2			1944 Year-class, age 3														
	Oregon			British Columbia			Washington			Oregon											
Length, mm.	VII			XI			VIII			VIII			VII			V			Total		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
154		1	1																		
156		1	1																		
158	1		1																		
160	2	2	4																		
162	1	1	2																		
164																					
166																					
168																					
170																					
172		1	1																		
174																					
176																					
178																					
180																					
182																					
184																					
186																					
188																					
190				1		1															
232											1	1								1	1
234													1		1				1		1
236																					
238																					
240								1	1				1		1				1		1
242							1		1												
244														1	1					1	1
246											2	2								2	2
248																					
250																					
252																					
254																					
256								1	1								1	1		1	1
Totals	4	6	10	1		1	1	2	3		3	3	2	1	3		1	1	2	5	7

TABLE 5

Length Composition of the 1943 Year-class, Age 4, by Areas in the Pacific Northwest in 1947

Area	British Columbia			Washington			Oregon																				
	XI			VIII			VIII			VII			VI			V			IV			Unrecorded			Total		
Length, mm.	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
230													--	1	1										--	1	1
232	1	--	1	1	--	1							1	--	1				1	--	1				2	--	2
234													--	1	1										--	1	1
236										1	--	1													1	--	1
238	1	1	2							1	--	1	1	--	1				1	--	1	--	1	1	3	1	4
240	1	1	2	1	--	1	--	1	1	3	--	3				1	2	3	1	--	1				5	3	8
242	2	--	2	--	1	1	--	1	1	3	1	4				--	1	1	--	1	1	--	1	1	3	5	8
244	2	1	3				1	--	1	2	2	4	--	1	1	--	1	1				1	1	2	4	5	9
246	--	1	1				--	2	2	1	--	1	1	--	1				1	--	1	1	--	1	4	2	6
248				2	--	2	3	2	5	2	--	2										--	1	1	5	3	8
250	2	2	4	1	1	2	--	1	1	--	3	3				1	1	2				1	1	2	2	6	8
252				1	1	2				3	--	3	1	--	1							1	1	2	5	1	6
254							1	2	3													--	1	1	1	3	4
256				--	2	2				--	1	1													--	1	1
258							--	1	1	1	2	3													1	3	4
260																											
262				--	1	1				--	2	2													--	2	2
Totals	9	6	15	6	6	12	5	10	15	17	11	28	4	3	7	2	5	7	4	1	5	4	7	11	36	37	73

TABLE 6

Length Composition of the 1942 Year-class, Age 5, by Areas in the Pacific Northwest in 1947

Area	British Columbia			Washington									Oregon																	
	XI			VIII			VI			Total			VIII			VII			VI			V			IV			Unrecorded			Total		
Length, mm.	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
234													--	1	1															--	1	1
236																			--	1	1	--	1	1							--	2	2
238																			--	1	1				1	--	1				1	1	2
240	2	--	2																--	1	1				1	--	1				1	1	2
242				1	--	1				1	--	1																			2	1	3
244	2	--	2	1	--	1				1	--	1	1	1	2	1	--	1													1	5	6
246	1	--	1	--	2	2				--	2	2	--	1	1	1	2	3	--	1	1							--	1	1	2	3	5
248	3	--	3	1	--	1				1	--	1	--	1	1	2	1	3				--	1	1							--	4	4
250	1	--	1	1	--	1				1	--	1	--	1	1	--	3	3													6	4	10
252	3	--	3	1	--	1				1	--	1				3	2	5	1	1	2	--	--	--	1	1	2	1	--	1	1	6	7
254	--	3	3	2	--	2				2	--	2	--	3	3	1	1	2							--	2	2				1	4	4
256	--	1	1	1	--	1				1	--	1	--	3	3							--	1	1							--	2	2
258																--	1	1										--	1	1	1	4	5
260				--	1	1				--	1	1	--	2	2	1	2	3														1	1
262				1	--	1				1	--	1				--	1	1													--	1	1
264	--	1	1	1	1	2				1	1	2							--	1	1										--	1	1
266							1	--	1	1	--	1	1	--	1																1	--	1
Totals	12	5	17	10	4	14	1	--	1	11	4	15	2	13	15	9	13	22	1	6	7	--	3	3	3	3	6	1	2	3	16	40	56

TABLE 7

Length Composition of the 1941 Year-class, Age 6, by Areas in the Pacific Northwest in 1947

Area	British Columbia			Washington- ton			Oregon																				
	XI			VIII			VIII			VII			VI			V			IV			Unrecorded			Total		
Length, mm.	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
234																			1	--	1				1		1
236																											
238																											
240	1	--	1																								
242					1	1											1	1								1	1
244				1	--	1	1	--	1	1	--	1	1	--	1										1		1
246	1	--	1							1	1	2					1	1	1	--	1				3	1	4
248				1	--	1	1	--	1	1	--	1							1	1	2				2	2	4
250	1	--	1				--	1	1	--	1	1	--	2	2				2	--	2	1	--	1	5	--	5
252	1	1	2	1	--	1	--	1	1	--	2	2	1	--	1				--	2	2					6	6
254				--	1	1				--	1	1	--	1	1										1	3	4
256				--	1	1	--	1	1	1	2	3	--	1	1				--	1	1					3	3
258	--	1	1				1	--	1													--	2	2	1	6	7
260																			1	1	2	1	--	1	3	1	4
262							--	1	1														1	1		2	2
264							--	1	1	--	1	1	1	--	1										1	2	3
266					1	1	--	2	2													1	--	1	1	2	3
268							--	1	1																--	1	1
270				1	--	1				--	1	1													--	1	1
Totals	4	2	6	4	4	8	3	8	11	4	10	14	3	4	7	--	2	2	6	5	11	3	3	6	19	32	51

TABLE 8

Length Composition of the 1940 Year-class, Age 7, by Areas in the Pacific Northwest in 1947

Length, mm.	British Columbia			Washington									Oregon																				
	XI			VIII			VI			Total			VIII			VII			VI			V			IV			Unrecorded			Total		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
240	1	--	1													1	1	2													1	1	2
242	--	1	1													1	1	1	1	--	1	1	--	1							2	1	3
244	1	--	1	1	--	1				1	--	1	1	--	1	2	--	2	1	--	1	--	1	1					1	1	4	2	6
246	1	1	2	3	--	3				3	--	3	1	--	1	1	--	1	--	--	--	2	2	4	1	--	1	1	--	1	6	2	8
248	2	2	4	1	1	2				1	1	2				1	1	2				1	--	1							2	1	3
250	2	2	4	1	--	1	1	--	1	2	--	2	2	2	4	3	--	3	1	1	2	1	--	1							7	3	10
252	2	--	2	1	--	1				1	--	1	1	--	1	1	2	3				1	.	1				1	--	1	4	2	6
254	2	--	2	1	1	2				1	1	2	1	--	1	2	2	4							1	1	2	--	1	1	4	4	8
256	2	3	5	4	1	5				4	1	5	1	1	2	--	4	4	--	2	2	--	1	1	--	2	2	1	--	1	2	10	12
258	1	--	1	2	--	2				2	--	2	1	1	2	1	1	2	--	1	1				1	--	1	--	1	1	3	4	7
260	1	--	1	1	1	2				1	1	2	--	1	1	--	2	2													1	3	4
262	--	3	3													--	2	2				--	1	1				1	3	4	1	6	7
264	1	1	2											1	1	--	1	1										--	1	1	--	3	3
266	--	--	--										1	--	1										--	1	1				1	1	2
268	--	1	1											1	1	--	2	2							--	1	1				--	4	4
270																												--	1	1	--	1	1
272				--	1	1				--	1	1																					
Totals	16	14	30	15	5	20	1	--	1	16	5	21	9	7	16	12	19	31	3	4	7	6	5	11	3	5	8	4	8	12	37	48	85

TABLE 9

Length Composition of the 1939 Year-class, Age 8, by Areas in the Pacific Northwest in 1947

Area	British Columbia			Washington									Oregon																	
	XI			VIII			VI			Total			VIII			VII			VI			V			IV			Unrecorded			Total		
Length, mm.	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
238	1	--	1																													
240													--	1	1																--	1	1
242	1	--	1																													
244	--	1	1				1	--	1	1	--	1																				
246	3	--	3	1	1	2				1	1	2							1	--	1	1	--	1							2	--	2
248	--	2	2										1	--	1	--	1	1	--	1	1	--	1	1	1	--	1				2	3	5
250				2	1	3				2	1	3				2	--	2	1	2	3							1	--	1	4	2	6
252	1	1	2				1	--	1	1	--	1	1	2	3	4	1	5							1	--	1				6	3	9
254	2	1	3				1	--	1	1	--	1	--	1	1				--	2	2				--	1	1				--	4	4
256	1	2	3	4	2	6				4	2	6	4	--	4	--	1	1	--	1	1	1	1	2							5	3	8
258	2	1	3	1	3	4				1	3	4	--	1	1	2	4	6							--	1	1	1	1	2	3	7	10
260	--	1	1	--	1	1				--	1	1	--	1	1	--	1	1										--	1	1	--	3	3
262	--	1	1	--	1	1				--	1	1	--	1	1																--	1	1
264	--	2	2	1	1	2				1	1	2				--	3	3	--	1	1				--	2	2				--	6	6
266							1	--	1	1	--	1	--	1	1	--	3	3	--	1	1				1	--	1				1	5	6
268				--	1	1				--	1	1	1	--	1													--	1	1	1	1	2
270	1	--	1													--	1	1													--	1	1
Totals	12	12	24	9	11	20	4	--	4	13	11	24	7	8	15	8	15	23	2	8	10	2	2	4	3	4	7	2	3	5	24	40	64

TABLE 10

Length Composition of the 1938 and 1937 Year-classes by Areas in the Pacific Northwest in 1947

Length, mm.	1938 Year-class, age 9																					1937 Year-class, age 10					
Area	British Columbia			Washington									Oregon									British Columbia			Oregon		
	XI			VIII			VI			Total			VIII			VII			Unrecorded			Total			XI			Unrecorded		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
246	--	1	1																											
248																--	1	1				--	1	1						
250	1	--	1										1	--	1							1	--	1						
252	1	--	1										--	1	1	1	--	1				1	1	2				1	--	1
254				1	--	1				1	--	1	1	--	1	2	--	2				3	--	3						
256	1	--	1				1	--	1	1	--	1																		
258				1	--	1				1	--	1																		
260																--	2	2	--	1	1	--	3	3	1	--	1			
262	--	1	1				1	--	1	1	--	1																		
264																														
266																														
268																														
270				--	1	1	--	1	1	--	2	2																		
272																														
274																														
276																														
278	--	1	1																											
Totals	3	3	6	2	1	3	2	1	3	4	2	6	2	1	3	3	3	6	--	1	1	5	5	10	1	--	1	1	--	1

TABLE 11

Length Composition of the 1947 and 1946 Year-classes in 1947-48

Length, mm.	1947 Year-class, age 0			1946 Year-class, age 1																				
	Grand[1] Total			Pacific Northwest			Monterey[2]			Monterey[3]			Monterey[4]			San Pedro			California			Grand Total		
	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
124	--	--	1																					
126	--	--	3													--	--	1	--	--	1	--	--	1
128	--	--	2																					
130	--	--	2																					
132	--	--	1													--	--	1	--	--	1	--	--	1
134	--	--	3													--	--	1	--	--	1	--	--	1
136	--	--	1																					
138																								
140																								
142																								
144																								
146	1	--	2																					
148																								
150																2	3	5	2	3	5	2	3	5
152	2	1	3													2	3	5	2	3	5	2	3	5
154	--	4	4	--	1	1										4	2	6	4	2	6	4	3	7
156				--	1	1										8	8	16	8	8	16	8	9	17
158	--	1	1	1	--	1										6	12	18	6	12	18	7	12	19
160	1	1	2	2	2	4										9	5	14	9	5	14	11	7	18
162	1	--	1	1	1	2	--	1	1				--	1	1	6	6	12	6	7	13	7	8	15
164	1	--	1				1	2	3				1	2	3	7	7	14	8	9	17	8	9	17
166	2	--	2				1	4	5				1	4	5	7	5	12	8	9	17	8	9	17
168							7	4	11				7	4	11	5	6	11	12	10	22	12	10	22
170							6	2	8				6	2	8	4	10	14	10	12	22	10	12	22
172				--	1	1	5	6	11				5	6	11	4	3	7	9	9	18	9	10	19
174							5	6	11				5	6	11	1	8	9	6	14	20	6	14	20
176							14	7	21				14	7	21	2	2	4	16	9	25	16	9	25
178							11	9	20				11	9	20	5	--	5	16	9	25	16	9	25

180							8	7	15				8	7	15	4	1	5	12	8	20	12	8	20
182							21	11	32				21	11	32	1	2	3	22	13	35	22	13	35
184							12	14	26				12	14	26	1	--	1	13	14	27	13	14	27
186							19	13	32				19	13	32	--	1	1	19	14	33	19	14	33
188							19	14	33				19	14	33	2	2	4	21	16	37	21	16	37
190							14	18	32	--	1	1	14	19	33	1	--	1	15	19	34	15	19	34
192							12	12	24				12	12	24	2	1	3	14	13	27	14	13	27
194							5	14	19				5	14	19	3	2	5	8	16	24	8	16	24
196							13	5	18	1	--	1	14	5	19	1	3	4	15	8	23	15	8	23
198							7	6	13	1	1	2	8	7	15	1	4	5	9	11	20	9	11	20
200							5	4	9				5	4	9	2	2	4	7	6	13	7	6	13
202							3	2	5				3	2	5	1	2	3	4	4	8	4	4	8
204							1	1	2				1	1	2	--	1	1	1	2	3	1	2	3
206							1	--	1				1	--	1				1	--	1	1	--	1
208																								
210							--	1	1				--	1	1				--	1	1	--	1	1
Totals	[1]	8	7	29[5]	4	6	10	190	163	353	2	2	4	192	165	357	91	101	195[5]	283	266	552[5]	287	272	562[5]

[1] Year-class represented only at San Pedro.
[2] Includes samples of fish caught locally.
[3] Samples of Southern California fish delivered in Monterey.
[4] Combined total of samples of local and Southern California fish delivered in Monterey.
[5] Includes some fish, sex unknown.

TABLE 12

Length Composition of the 1945 Year-class, Age 2, in 1947-48

Area	Pacific Northwest			Monterey[1]			Monterey[2]			Monterey[3]			San Pedro			California			Grand Total		
Length, mm.	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
176				1	--	1				1	--	1				1	--	1	1	--	1
178				--	1	1				--	1	1				--	1	1	--	1	1
180																					
182				1	1	2				1	1	2				1	1	2	1	1	2
184							1	--	1	1	--	1				1	--	1	1	--	1
186				--	1	1				--	1	1				--	1	1	--	1	1
188				1	1	2				1	1	2				1	1	2	1	1	2
190	1	--	1	1	--	1	1	--	1	2	--	2	1	--	1	3	--	3	4	--	4
192				2	2	4	--	1	1	2	3	5	1	--	1	3	3	6	3	3	6
194				--	5	5	3	1	4	3	6	9	4	2	6	7	8	15	7	8	15
196				--	2	2	6	2	8	6	4	10	--	1	1	6	5	11	6	5	11
198				3	2	5	4	4	8	7	6	13	9	6	15	16	12	28	16	12	28
200				4	1	5	5	4	9	9	5	14	11	10	21	20	15	35	20	15	35
202				7	4	11	6	4	10	13	8	21	9	8	17	22	16	38	22	16	38
204				8	2	10	3	3	6	11	5	16	15	8	23	26	13	39	26	13	39
206				4	6	10	4	3	7	8	9	17	16	20	36	24	29	53	24	29	53
208				2	8	10	2	2	4	4	10	14	7	16	23	11	26	37	11	26	37
210				3	2	5	2	1	3	5	3	8	13	18	31	18	21	39	18	21	39
212				1	1	2	2	7	9	3	8	11	7	7	14	10	15	25	10	15	25
214				2	4	6	2	2	4	4	6	10	9	8	17	13	14	27	13	14	27
216				--	1	1	1	3	4	1	4	5	9	7	16	10	11	21	10	11	21
218				1	--	1	--	5	5	1	5	6	4	6	10	5	11	16	5	11	16
220				--	2	2	3	--	3	3	2	5	4	8	12	7	10	17	7	10	17
222				2	1	3	2	3	5	4	4	8	1	4	5	5	8	13	5	8	13
224							--	2	2	--	2	2	1	4	5	1	6	7	1	6	7
226				1	2	3	--	2	2	1	4	5	--	3	3	1	7	8	1	7	8
228				1	--	1	--	4	4	1	4	5	3	3	6	4	7	11	4	7	11
230							1	1	2	1	1	2	5	3	8	6	4	10	6	4	10
232							1	--	1	1	--	1	--	3	3	1	3	4	1	3	4
234				2	3	5				2	3	5	--	6	6	2	9	11	2	9	11
236				--	1	1				--	1	1				--	1	1	--	1	1
238													--	1	1	--	1	1	--	1	1
Totals	1	0	1	47	53	100	49	54	103	96	107	203	129	152	281	225	259	484	226	259	485

[1] Includes samples of fish caught locally.
[2] Samples of Southern California fish delivered in Monterey.
[3] Combined total of samples of local and Southern California fish delivered in Monterey.

TABLE 13

Length Composition of the 1944 Year-class, Age 3, in 1947-48

Area	Pacific Northwest			Monterey[1]			Monterey[2]			Monterey[3]			San Pedro			California			Grand Total		
Length, mm.	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
186																					
188																					
190													1		1	1		1	1		1
192														1	1		1	1		1	1
194					1	1					1	1	3		3	3	1	4	3	1	4
196													1		1	1		1	1		1
198													3	1	4	3	1	4	3	1	4
200														1	1		1	1		1	1
202							1		1	1		1	1	1	2	2	1	3	2	1	3
204							2		2	2		2	7	2	9	9	2	11	9	2	11
206							1	2	3	1	2	3	2	2	4	3	4	7	3	4	7
208							1	2	3	1	2	3	6	4	10	7	6	13	7	6	13
210							1	3	4	1	3	4	7	4	11	8	7	15	8	7	15
212								2	2		2	2	2	4	6	2	6	8	2	6	8
214					1	1	2		2	2	1	3	3	7	10	5	8	13	5	8	13
216							2	3	5	2	3	5	5	5	10	7	8	15	7	8	15
218							1	5	6	1	5	6	5	5	10	6	10	16	6	10	16
220								1	1		1	1	4	2	6	4	3	7	4	3	7
222							5	1	6	5	1	6	3	2	5	8	3	11	8	3	11
224							3	4	7	3	4	7	3	8	11	12	6	18	12	6	18
226							1	3	4	1	3	4	4	4	8	5	7	12	5	7	12
228							1	3	4	1	3	4	4	5	9	5	8	13	5	8	13
230							1	1	2	1	1	2	5	2	7	6	3	9	6	3	9
232					1	1	2	1	3	2	2	4	2	3	5	4	5	9	4	6	10
234	1		1	1	1	2	1	1	2	2	2	4	7	1	8	9	3	12	10	3	13
236							1	1	2	1	1	2	2	4	6	3	5	8	3	5	8
238								1	1		1	1	3	4	7	3	5	8	3	5	8
240	1	1	2					2	2		2	2		3	3		5	5	1	6	7
242	1		1											2	2		2	2	1	2	3
244		1	1	1	1	2				1	1	2				1	1	2	1	2	3
246		2	2											1	1		1	1		3	3
248																					
250																					
252																					
254																					
256		2	2																	2	2
Totals	3	7	10	2	5	7	26	36	62	28	41	69	89	72	161	117	113	230	120	120	240

[1] Includes samples of fish caught locally.
[2] Samples of Southern California fish delivered in Monterey.
[3] Combined total of samples of local and Southern California fish delivered in Monterey.

TABLE 14

Length Composition of the 1943 Year-class, Age 4, in 1947-48

Area	Pacific Northwest			Monterey[1]			Monterey[2]			Monterey[3]			San Pedro			California			Grand Total		
Length, mm.	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
200													1	--	1	1	--	1	1	-	1
202													1	--	1	1	--	1	1	-	1
204							--	1	1	--	1	1	1	1	2	1	2	3	1	2	3
206							--	1	1	--	1	1	1	--	1	1	--	1	1	--	1
208							--	1	1	--	1	1	2	--	2	2	1	3	2	1	3
210							1	--	1	1	--	1	2	1	3	3	1	4	3	1	4
212							1	--	1	1	--	1	3	3	6	3	3	6	3	3	6
214							1	--	1	1	--	1	1	--	1	2	--	2	2	-	2
216							5	--	5	5	--	5	4	1	5	4	1	5	4	1	5
218							1	1	2	1	1	2	1	1	2	2	2	4	2	2	4
220							1	3	4	1	3	4	4	1	5	4	1	5	4	1	5
222							5	--	5	5	--	5	2	1	3	7	1	8	7	1	8
224							1	3	4	1	3	4	4	1	5	5	4	9	5	4	9
226													4	3	7	4	3	7	4	3	7
228		1	1				4	--	4	4	--	4	2	3	5	6	3	9	6	4	10
230	4	--	4										3	2	5	3	2	5	7	2	9
232	--	1	1				4	--	4	4	--	4	3	2	5	7	2	9	7	3	10
234	1	-	1				2	-	2	2	--	2	2	1	3	4	1	5	5	1	6
236	4	2	6				3	1	4	3	1	4	2	4	6	5	5	10	9	7	16
238	7	4	11				2	2	4	2	2	4	--	3	3	2	5	7	9	9	18
240	5	6	11										1	3	4	1	3	4	6	9	15
242	6	6	12	--	1	1	--	1	1	--	2	2	--	4	4	--	6	6	6	12	18
244	4	3	7										--	2	2	--	2	2	4	5	9
246	7	3	10				--	2	2	--	2	2				-	2	2	7	5	12
248	5	9	14										--	2	2	--	2	2	5	11	16
250	6	2	8	1	1	2				1	1	2				1	1	2	7	3	10
252	1	3	4																1	3	4
254	--	3	3																--	3	3
256	1	3	4																1	3	4
258																					
260	--	3	3																--	3	3
262																					
Totals	51	49	100	1	2	3	24	12	36	25	14	39	44	39	83	69	53	122	120	102	222

[1] Includes samples of fish caught locally.
[2] Samples of Southern California fish delivered in Monterey.
[3] Combined total of samples of local and Southern California fish delivered in Monterey.

TABLE 15

Length Composition of the 1942 Year-class, Age 5, in 1947-48

Area	Pacific Northwest			Monterey[1]			Monterey[2]			Monterey[3]			San Pedro			California			Grand Total		
Length, mm.	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
206							1	--	1	1	--	1				1	--	1	1	--	1
208																					
210																					
212							--	2	2	--	2	2				--	2	2	--	2	2
214							1	--	1	1	--	1				1	--	1	1	--	1
216													1	--	1	1	--	1	1	--	1
218													--	1	1	--	1	1	--	1	1
220													1	1	2	1	1	2	1	1	2
222							--	1	1	--	1	1				--	1	1	--	1	1
224													1	1	2	1	1	2	1	1	2
226							--	2	2	--	2	2	1	1	2	1	3	4	1	3	4
228							1	--	1	1	--	1	--	1	1	1	1	2	1	1	2
230													--	1	1	--	1	1	--	1	1
232							--	2	2	--	2	2	--	2	2	--	4	4	--	4	4
234	--	1	1				2	--	2	2	--	2	4	2	6	6	2	8	6	3	9
236							1	1	2	1	1	2	2	1	3	3	2	5	3	2	5
238	--	2	2				--	2	2	--	2	2	2	3	5	2	5	7	2	7	9
240	3	1	4				2	1	3	2	1	3	4	1	5	6	2	8	9	3	12
242	2	1	3										1	1	2	1	1	2	3	2	5
244	5	1	6										1	2	3	1	2	3	6	3	9
246	2	7	9	--	1	1	--	1	1	--	2	2	1	--	1	1	2	3	3	9	12
248	6	3	9	1	--	1				1	--	1	--	2	2	1	2	3	7	5	12
250	2	4	6				--	2	2	--	2	2	--	3	3	--	5	5	2	9	11
252	10	4	14	--	1	1				--	1	1	--	1	1	--	2	2	10	6	16
254	3	9	12										--	1	1	--	1	1	3	10	13
256	1	5	6	--	1	1				--	1	1	--	1	1	--	2	2	1	7	8
258	--	2	2																--	2	2
260	1	5	6				--	1	1	--	1	1				--	1	1	1	6	7
262	1	1	2																1	1	2
264	1	3	4																1	3	4
266	2	--	2																2	--	2
Totals	39	49	88	1	3	4	8	15	23	9	18	27	19	26	45	28	44	72	67	93	160

[1] Includes samples of fish caught locally.
[2] Samples of Southern California fish delivered in Monterey.
[3] Combined total of samples of local and Southern California fish delivered in Monterey.

TABLE 16

Length Composition of the 1941 Year-class, Age 6, in 1947-48

Area	Pacific Northwest			Monterey[1]			San Pedro			California			Grand Totals		
Length, mm.	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
218				--	1	1				--	1	1	--	1	1
220				1	--	1				1	--	1	1	--	1
222															
224															
226															
228				1	--	1	--	1	1	1	1	2	1	1	2
230							1	1	2	1	1	2	1	1	2
232				1	--	1	1	2	3	2	2	4	2	2	4
234	1	--	1	--	1	1				--	1	1	1	1	2
236				1	--	1				1	--	1	1	--	1
238				1	1	2	1	--	1	2	1	3	2	1	3
240	1	1	2				1	--	1	1	--	1	2	1	3
242	1	1	2	1	--	1	--	2	2	1	2	3	2	3	5
244	4	1	5										4	1	5
246	3	2	5										3	2	5
248	6	--	6										6	--	6
250	1	6	7										1	6	7
252	3	4	7										3	4	7
254	--	4	4	--	1	1				--	1	1	--	5	5
256	1	7	8				1	--	1	1	--	1	2	7	9
258	3	2	5										3	2	5
260	--	2	2										--	2	2
262	1	2	3										1	2	3
264	1	3	4										1	3	4
266	--	1	1										--	1	1
268	1	1	2										1	1	2
270	--	1	1										--	1	1
Totals	27	38	65	6	4	10	5	6	11	11	10	21	38	48	86

[1] Samples of Southern California fish delivered in Monterey.

TABLE 17

Length Composition of the 1940, 1939, 1938 and 1937 Year-classes in 1947-48

Area	1940 Year-class, age 7									1939 Year-class, age 8													1938 Year-class, age 9									1937 Year-class, age 10		
	Pacific Northwest			California[1]			Grand Total			Pacific Northwest			Monterey[2]			San Pedro			California			Grand Total			Pacific Northwest			California[3]			Grand Total			Grand Total[4]		
Length, mm.	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T	M	F	T
230					1	1		1	1																											
232																	1	1		1	1		1	1												
234																																				
236														1	1					1	1		1	1												
238					1	1		1	1	1		1										1		1												
240	2	1	3				2	1	3		1	1											1	1												
242	2	2	4				2	2	4	1		1										1		1												
244	6	2	8				6	2	8	1	1	2										1	1	2					1	1			1	1		
246	10	3	13				10	3	13	6	1	7										6	1	7		1	1					1	1			
248	5	4	9				5	4	9	2	5	7										2	5	7		1	1					1	1			
250	11	5	16				11	5	16	6	3	9										6	3	9	2		2				2		2			
252	7	2	9		1	1	7	3	10	8	4	12										8	4	12	2	1	3				2	1	3	1		1
254	7	5	12				7	5	12	3	5	8										3	5	8	4		4				4		4			
256	8	14	22				8	14	22	10	7	17										10	7	17	2		2				2		2			
258	6	4	10				6	4	10	6	11	17										6	11	17	1		1				1		1			
260	2	4	6				2	4	6		5	5											5	5		3	3					3	3	1		1
262	1	9	10				1	9	10		3	3											3	3	1	1	2				1	1	2			
264	1	4	5				1	4	5	1	9	10		1	1					1	1	1	10	11												
266	1	1	2				1	1	2	2	5	7										2	5	7												
268		5	5					5	5	1	2	3										1	2	3												
270		1	1					1	1	1	1	2										1	1	2		2	2					2	2			
272		1	1					1	1																											
274																																				
276																																				
278																										1	1					1	1			
Totals	69	67	136		3	3	69	70	139	49	63	112		2	2		1	1		3	3	49	66	115	12	10	22		1	1	12	11	23	2		2

[1] Year-class represented in California only at San Pedro.
[2] Year-class represented locally only.
[3] Year-class represented in California only from catches landed in Southern California and trucked to Monterey.
[4] Year-class represented in Pacific Northwest only.

TABLE 18

Age (Year-class) Composition of the Sardine Catch in the 1947-48 Season (Numbers of Fish Are Given in Thousands, i.e., 000 Omitted)

	Catch		Numbers of Fish by Age (Year-class)										
			0	1	2	3	4	5	6	7	8	9	10
	Tons	Number	1947	1946	1945	1944	1943	1942	1941	1940	1939	1938	1937
Pacific Northwest—													
British Columbia	485	1,891			19		284	322	113	567	454	113	19
Washington	1,356	5,719				193	771	964	514	1,350	1,542	385	
Oregon	6,926	29,578		828		580	6,049	4,641	4,224	7,042	5,303	828	83
Totals, Pacific Northwest	8,767	37,188		828	19	773	7,104	5,927	4,851	8,959	7,299	1,326	102
California—													
San Francisco[4]													
Totals, San Francisco Local[1]	82	816		614	174	12	5	7			4		
Totals, San Francisco-So. Calif.[2]	294	2,510		42	1,082	651	378	242	105				10
Totals, San Francisco	376	3,326		656	1,256	663	383	249	105		4		10
Monterey													
"August"[1]	7,320	73,830		37,233	21,167	7,198	4,068	2,813	1,041		207	103	
"September"[1]	2,187	19,138		9,651	5,487	1,866	1,054	729	270		54	27	
"October"[2]	1,241	9,200		4,640	2,637	897	507	350	130		26	13	
"November"[2]	1,446	8,863		4,470	2,541	864	488	338	125		25	12	
"December"[1]	296	2,587		1,947	552	39	16	22				11	
"December"[2]	123	709		12	305	184	107	68	30			3	
Totals, "December"	419	3,296		1,959	857	223	123	90	30			14	
"January"[1]	506	4,704		2,372	1,349	459	259	179	66		13	7	
"February"[1]	1,329	12,751		6,430	3,656	1,243	702	486	180		36	18	
Totals, Monterey local[1]	11,638	113,010		57,633	32,211	10,805	6,099	4,229	1,557		310	166	
Totals, Monterey-So. Calif.[2]	2,810	18,772		9,122	5,483	1,945	1,102	756	285		51	28	
Totals, Monterey combined	14,448	131,782		66,755	37,694	12,750	7,201	4,985	1,842		361	194	

San Pedro													
"October"	64,375	481,113	17,272	115,948	167,091	95,790	49,362	26,750	6,543	1,780	577	----	----
"November"	14,940	99,407	3,569	23,957	34,524	19,792	10,199	5,527	1,352	368	119	----	----
"December"	2,866	18,745	673	4,518	6,510	3,732	1,923	1,042	255	69	23	----	----
"January"	1,624	22,554	810	5,436	7,833	4,490	2,314	1,254	307	83	27	----	----
"February"	9,096	152,697	5,482	36,800	53,031	30,402	15,667	8,490	2,077	565	183	----	----
Totals, San Pedro	92,901	774,516	27,806	186,659	268,989	154,206	79,465	43,063	10,534	2,865	929	----	----
San Diego[3]	2,413	17,864	642	4,305	6,203	3,557	1,833	993	244	66	21	----	----
Totals, California	110,138	927,488	28,448	258,375	314,142	171,176	88,882	49,290	12,725	2,931	1,315	194	10
Grand totals, Pacific Coast	118,905	964,676	28,448	259,203	314,161	171,949	95,986	55,217	17,576	11,890	8,614	1,520	112

[1] Fish caught north of Point Conception.
[2] Fish caught south of Point Conception and trucked to central California port.
[3] All values for San Diego, except tons landed, were prorated from San Pedro totals.
[4] All values for San Francisco, except tons landed, were prorated from Monterey totals.

TABLE 19

Number of Fish, Mean Length, and Standard Error of the Mean for Each Year-class in 1947-48 by Region of Catch

Year-class	Pacific Northwest												California								
	British Columbia			Washington			Oregon			Total			Local Monterey			So. California Monterey			San Pedro		
	No.	M.	S.E.	No.	M.	S.E.	No.	M.	S.E.	No.	M.	S.E.	No.	M.	S.E.	No.	M.	S.E.	No.	M.	S.E.
1947—																					
Male																			8	158	2.67
Female																			7	155	1.06
Totals																			29	144	2.67
1946—																					
Male							4	160	.81	4	160	.81	190	184	.32	2	196	.50	91	169	1.38
Female							6	161	2.57	6	161	2.57	163	185	.36	2	194	2.00	101	170	1.43
Totals							10	160	1.51	10	160	1.51	353	185	.18	4	195	.95	195	169	1.03
1945—																					
Male	1	190	....							1	190	....	47	205	.85	49	204	.71	129	208	.77
Female													53	206	.89	54	210	.71	152	212	.81
Totals	1	190	....							1	190	....	100	206	.61	103	208	.53	281	210	.57
1944—																					
Male				1	242	....	2	237	2.12	3	239	2.43	2	238	2.50	26	219	.96	89	218	1.29
Female				2	248	8.00	5	245	3.80	7	246	3.22	5	223	4.42	36	221	.80	7	221	1.72
Totals				3	246	5.09	7	243	3.10	10	244	2.53	7	228	3.41	62	220	.61	161	219	.98
1943—																					
Male	9	242	1.91	6	245	3.13	36	245	1.01	51	244	.86	1	252	....	24	229	.78	44	223	1.52
Female	6	245	1.61	6	253	2.77	37	247	1.23	49	248	1.04	2	248	2.00	12	230	1.97	39	233	1.82
Totals	15	243	1.39	12	249	2.29	73	246	.92	100	246	.69	3	249	1.34	36	230	.85	83	228	1.28
1942—																					
Male	12	247	1.27	11	254	2.34	16	250	1.65	39	250	1.07	1	248	....	8	228	2.21	19	235	1.84
Female	5	256	1.90	4	254	4.73	40	251	1.09	49	252	1.01	3	251	1.46	15	234	1.78	26	239	2.09
Totals	17	250	1.50	15	254	2.03	56	251	.92	88	251	.73	4	252	1.16	23	232	1.36	45	237	1.45

1941—																		
Male	4	247	2.66	4	253	5.31	19	250	1.74	27	250	1.49				6	232	1.61	5	239	4.58
Female	2	255	3.00	4	254	4.50	32	255	1.26	38	255	1.12				4	236	3.70	6	234	2.49
Totals	6	250	2.50	8	254	3.25	51	253	1.07	65	253	.95				10	234	1.66	11	237	2.48
1940—																		
Male	16	252	1.55	16	252	1.29	37	250	.97	69	251	.69									
Female	14	255	2.11	5	258	4.00	48	257	1.05	67	256	.66							3	240	8.60
Totals	30	253	1.30	21	254	1.43	85	254	.49	136	253	.61							3	240	8.60
1939—																		
Male	12	252	2.47	13	254	1.73	24	254	1.13	49	253	.93									
Female	12	256	1.87	11	258	1.83	40	258	1.06	63	258	.82	2	250	7.00				1	232	
Totals	24	254	1.58	24	256	1.29	64	256	.83	112	256	.64	2	250	7.00				1	232	
1938—																		
Male	3	253	1.41	4	258	1.73	5	253	.80	12	254	1.57									
Female	3	262	9.19	2	270	.00	5	256	2.50	10	261	3.21				1	244				
Totals	6	257	4.65	6	262	2.86	10	254	1.33	22	257	1.66				1	244				
1937—																		
Male	1	260					1	252		2	256	4.00									
Female																					
Totals	1	260					1	252		2	256	4.00									

TABLE 20

Calendar Dates for Lunar Months for the 1947 Interseason and 1947-48 Season

"February"	February	6 - March	7
"March"	March	8 - April	5
"April"	April	6 - May	5
"May"	May	6 - June	3
"June"	June	4 - July	3
"July"	July	4 - August	1
"August"	August	2 - August	30
"September"	August	31 - September	28
"October"	September	29 - October	28
"November"	October	29 - November	27
"December"	November	28 - December	26
"January"	December	27 - January	25
"February"	January	26 - February	24
"March"	February	25 - March	25

SOME UNUSUAL OCCURRENCES OF FISH ON THE PACIFIC COAST[1]

By John E. Fitch
Bureau of Marine Fisheries
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The following fishes have come to the attention of the California State Fisheries Laboratory since those last reported by Fitch (1948). Their occurrence is unusual enough to make desirable a published record.

Ophiodon elongatus Girard, Lingcod

On March 27, 1948, a seven-pound lingcod was taken about 10 miles north of Ensenada, Lower California, on hook and line using salted anchovy for bait. The specimen was caught by the author in 60 feet of water while fishing from the Bureau of Marine Fisheries research vessel, the "N. B. Scofield."

Previously San Diego was given as the southern limit of the range of this species; therefore, this latest record extends the known distribution by nearly 60 miles. Fishermen have reported taking lingcod in the vicinity of San Quintin Bay, Lower California, but the above is thought to be the first definite record of its existence below San Diego.

Icichthys lockingtoni Jordan and Gilbert (Fig. 2)

On March 31, 1948, Mr. Edward C. Greenhood of the California State Fisheries Laboratory using a dip net scooped a large purple-striped jellyfish *Pelagia* sp. from the water about two miles off Seal Beach and found a very interesting fish also in his net. It turned out to be the rare fish *Icichthys lockingtoni*, which lives commensally within the gastrovascular cavity of large jellyfish. It was approximately $2\frac{1}{8}$ inches (55 mm.) in total length and quite delicate in appearance, and somewhat transparent in a strong light. It was first recorded from the Pacific Coast by Hobbs (1929).

Macrorhamphosus gracilis (Lowe), Slender Snipefish (Fig. 3)

Numerous snipefish were collected by various members of the staff of the Bureau of Marine Fisheries aboard the research vessel "N. B. Scofield" on the trip into Mexican waters during the spring of 1948. These were taken at night in a dip net when they swam under a light hanging from the stern of the vessel. Some were collected at each of the following localities on the dates indicated.

April 3, 1948—northeast end of Guadalupe Island, Lower California.
April 9, 1948—San Quintin Bay, Lower California.
April 12, 1948—Asuncion Bay, Lower California.
April 18, 1948—San Juanico Bay, Lower California.
April 26, 1948—San Quintin Bay, Lower California.

[1] Submitted for publication September, 1948.

Those collected varied in size from about one inch to two and one-quarter inches. This species was previously reported as *M. hawaiiensis* from Catalina Island, California, by Thompson (1920).

Salmo gairdnerii Richardson, Steelhead Rainbow Trout

On April 7, 1948, two Los Angeles fishermen caught a gravid female steelhead approximately two feet in total length while fishing with hook and line in the Los Angeles Harbor turning basin. Steelhead are often taken at Malibu some 25 miles north of the Los Angeles Harbor area, and near San Clemente about the same distance to the south, but they seldom appear in the harbor itself and even more rarely so far into the intricate network of channels that makes up the docking area.

Ophichthus zophochir Jordan and Gilbert, Yellow Snake Eel

A yellow snake eel approximately 18 inches (45 cm.) in total length was taken on April 14, 1948, by Mr. Herbert W. Davis aboard the "N. B. Scofield" at San Hipolito Bay, Lower California, on a hand line baited with cut anchovy. The line was fished on the bottom in about 60 feet of water. According to Barnhart (1936) the range of this species is from Los Angeles County to Panama; however, actual records of its occurrence within this range are spotty. The present record is presented to supplement prior data on a form not too frequently taken.

Chloroscombrus orqueta Jordan and Gilbert, Yellowtail Jack (Fig. 4)

Two of these fish, members of the jack family (Carangidae), were snagged as they swam under a light suspended from the stern of the "N. B. Scofield" while anchored at San Quintin Bay on the night of April 26, 1948. The first record of this species north of Magdalena Bay was reported by Fry (1940) from the vicinity of San Pedro. Those taken at San Quintin Bay were approximately 10 inches in total length, and their capture there helps fill in gaps in the known range.

Xesurus hopkinsi Gilbert and Starks, Surgeon Fish

When the tuna fishing boat "Mary Barbara" reached its home port of San Diego on May 6, 1948, a strange fish was found in the bait tank. Mr. Arsene Christopher of that boat presented it to the Division of Fish and Game at San Diego. It was then sent to Dr. Carl L. Hubbs at Scripps Institution of Oceanography, La Jolla, who identified it as a surgeon fish. This is apparently the second record of *Xesurus hopkinsi*. It was previously known only from the type specimen taken in Panama Bay. The "Mary Barbara" had made two bait hauls during the period it had been fishing, the first in the Gulf of California and the second at Panama Bay. The skipper could not state at which of these two localities the fish in question was taken, but in view of the type specimen having been taken in Panama Bay it is logical to assume this second specimen was also taken there.

Roccus saxatilis (Walbaum), Striped Bass

On May 10, 1948, the fishing boat "Ralphy Boy" delivered a load of mixed sardines and Jack mackerel which had been taken off Huntington Beach to the Los Angeles Fish and Oyster Company, San Pedro. In the load of fish was a 10-inch striped bass which was turned over to the California State Fisheries Laboratory. The occurrence of striped bass south

of Monterey Bay is unusual, though probably more are taken by fishermen each year than are ever recorded. Attempts have been made in early years to introduce the species into Southern California but with no apparent success. The first record of striped bass taken in Southern California was reported from Mission Bay, San Diego County, in June, 1919, by Scofield (1919). Others are recorded by Scofield (1931, 1939) and Walford (1931).

An unpublished record of a specimen taken from the Mission Bay Bridge, San Diego County, on May 27, 1947, is entered in the Scripps Institution of Oceanography field book No. H47-116. It was caught by C. E. Pinkston of San Diego and measured $21\frac{3}{4}$ inches in standard length and weighed $7\frac{3}{4}$ pounds. Observation and measurements were made by Boyd W. Walker, and this record is included here through the courtesy of Dr. Carl L. Hubbs of Scripps Institution of Oceanography.

Oncorhynchus tshawytscha (Walbaum), King Salmon

A 17-pound king salmon was taken by a commercial fishing boat off Pacific Beach, San Diego County, on May 10, 1948, and reported to the San Diego office of the California Division of Fish and Game. This is as far south as king salmon have previously been taken. Other records of this species from Southern California waters are by Croker (1930 and 1936) and Daugherty (1946).

Argentina sialis Gilbert, Pacific Argentine

A seven-inch specimen was picked up by Mr. Edward C. Greenhood of the California State Fisheries Laboratory during a routine check of an area where a charge of explosives had been set off about six miles east of Gaviota on June 30, 1948. The explosives were detonated just beneath the surface in water approximately 200 feet deep and the Pacific argentine was killed and left floating on the surface as a result of this blast. Barnhart (1936) gives the range for this species as Southern California in deep water, and the length of the fish to about three inches. Higgins (1920) states that over 300 were taken by the California Division of Fish and Game research boat "Albacore" during its investigations off Huntington Beach. Prior to those taken by the "Albacore" only the type specimen was known.

Two smaller specimens (80 to 88 mm.) were picked up by Mr. Ray Scott of the California State Fisheries Laboratory on August 26, 1948. These were also taken in the vicinity of Pt. Conception and were killed as the result of an explosion. Follett (1945) records two large specimens from Monterey Bay and corrects data on the type locality.

Tetragonurus cuvieri Risso, Squaretail (Fig. 5)

An 11-inch (280 mm.) squaretail was taken by the "N. B. Scofield" on the night of July 5, 1948, in gill nets fished 12 to 20 fathoms beneath the surface at Lat. 35° 33′ N., Long. 122° 55′ W. Also taken in the nets the same night were one albacore, 29 very large jack mackerel, 12 great blue sharks and one fish mutilated beyond recognition. This very rare fish is most common in the Mediterranean Sea though quite rare even there. Only a few specimens have ever been taken on the coasts of North America. Thompson (1919) mentions an adult caught by a commercial fisherman near San Pedro in 1917. He also records larvae of this species that were taken by the "Albacore" during its investigations.

Through the courtesy of Dr. Carl L. Hubbs of Scripps Institution of Oceanography at La Jolla, California, the capture of a squaretail in 1947 is recorded as follows: The specimen was enclosed in a tunicate *Pyrosoma* and was dipped up by Mr. Edgar E. Rock on January 27, 1947, approximately four and one-half miles off Bird Rock, San Diego County, California. It is recorded in Scripps Institution notebook under the number H47-13; the specimen itself was sent to Stanford University in May, 1947.

Lowe (18—) describes one from Madeira as *Tetragonurus atlanticus*. Other specimens have been taken off Hawaii and the east coast of Australia. In the Mediterranean area the flesh of this species is considered poisonous. The specimen taken by the "N. B. Scofield" will be published upon in detail at some future date.

Synodus lucioceps (Ayres), California Lizard Fish (Fig. 6)

On July 9, 1948, a 23-inch lizard fish (582 mm.) was brought to the California State Fisheries Laboratory by Mr. Norman Shidler. The fish had been taken off Avalon, Santa Catalina Island, on hook and line. Since Barnhart (1936) gives the length of this species to 18 inches the present specimen is considered of some interest. It has been included in the Stanford University collection.

Hydrolagus collici (Lay and Bennett), Ratfish

Among the most peculiar appearing fish to be taken on our coast is the ratfish, the only member of the family Chimaeridae recorded on the Pacific coast of North America. As far as can be determined the range for this species is recorded as from San Diego to Alaska. However during July, 1948, Mrs. Billie S. Johnston, of Van Nuys, California, caught one while night fishing below Ensenada, Lower California. A photograph of her catch was sent to the California State Fisheries Laboratory and identification confirmed. This latest record therefore extends the southern range of this fish by some 60 or 70 miles.

Caranax caninus Gunther, Jack-crevally (Fig. 7)

On August 5, 1948, approximately 100 jack-crevally ranging between 15 and 25 pounds were brought into the San Pedro fresh fish markets by the coastal freighter "Las Vegas." They had been bought from the natives at San Hipolito Bay, Lower California, who had caught them at that locality. The flesh of these fish is very dark and has an exceptionally strong odor, and according to reports they are so unpalatable even the Indians along the coast of Mexico will not eat them. According to Walford (1937) the range for this species is Cape San Lucas along both sides of the Gulf of California, southward to Guayaquil, Ecuador. The present specimens therefore extend the northern range of these fish by some 300 miles.

In all of the fish examined the stomachs were quite distended with food which more or less confirms the report that a jack-crevally is a voracious feeder. The stomach contents of a single individual showed the remains of many sardines, two lizard fish and several unidentifiable specimens of varying sizes.

Lophotus sp?, Oarfish (Fig. 8)

On August 20, 1948, Mr. C. E. Steller of Ventura, California, hooked and landed a 39-inch, seven-pound oarfish while fishing from the live bait boat "Sportfisher" which operates out of San Pedro. The boat was drifting over a school of albacore some six miles off Long Point, Santa Catalina Island. As the albacore were being taken down to several hundred feet most of the fishermen had weighted their lines and were fishing at varying depths. Mr. Steller had put a live anchovy on his hook and let some 300 feet of line run off his reel when he had a solid strike and hooked what he thought was an albacore. The fish put up a very good fight and it was some time before it was brought to the surface and gaffed. It has been identified as an oarfish, probably *Lophotes cristatus* (Johnson), a specimen of which was taken at Madeira around 1860.

Higgins (1920) reports an oarfish taken in the surf at Long Beach, California, in 1919 and stated that it was the first North American record for this interesting fish. Like or closely related specimens have been taken in the Mediterranean Sea, at the Cape of Good Hope, in New Zealand, near the Madeira Islands, and off Japan.

The present specimen is preserved at Scripps Institution of Oceanography at La Jolla, California, and further details will be published at some future date.

Scomberomorus sierra Jordan and Starks, Sierra

On August 23, 1948, Mr. Joe Ferrara of Los Angeles took a 4-pound, 13-ounce sierra while fishing from the pier at Redondo Beach, California. He was using live anchovies for bait and had been catching bonito and barracuda when the sierra struck. This species is rare north of Lower California and has not been recorded north of Santa Monica Bay. Daugherty (1946) last reported sierra from Southern California.

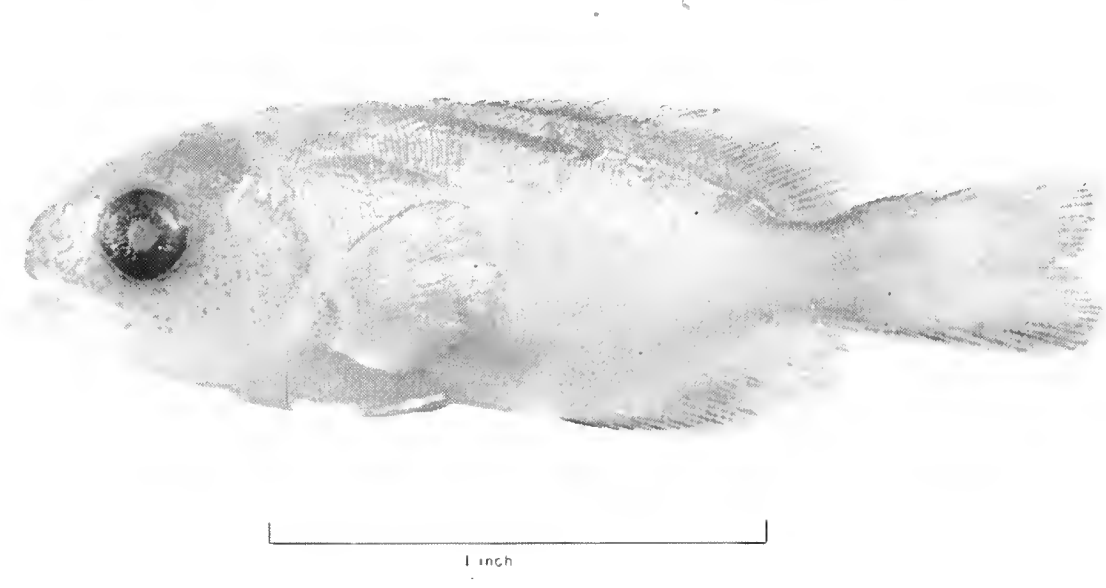

FIGURE 2. *Icichthys lockingtoni*. Photograph by Al Johns for Vernon M. Haden, San Pedro

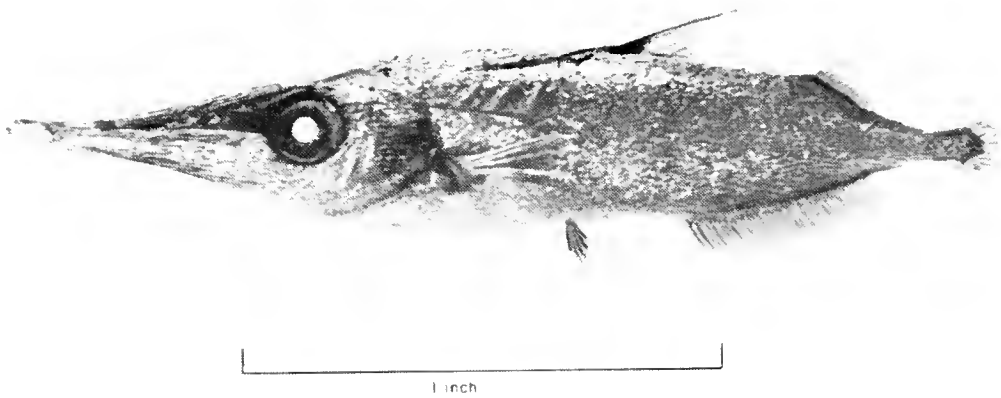

FIGURE 3. Slender Snipefish, *Macrorhamphosus gracilis*. Photograph by Al Johns for Vernon M. Haden, San Pedro

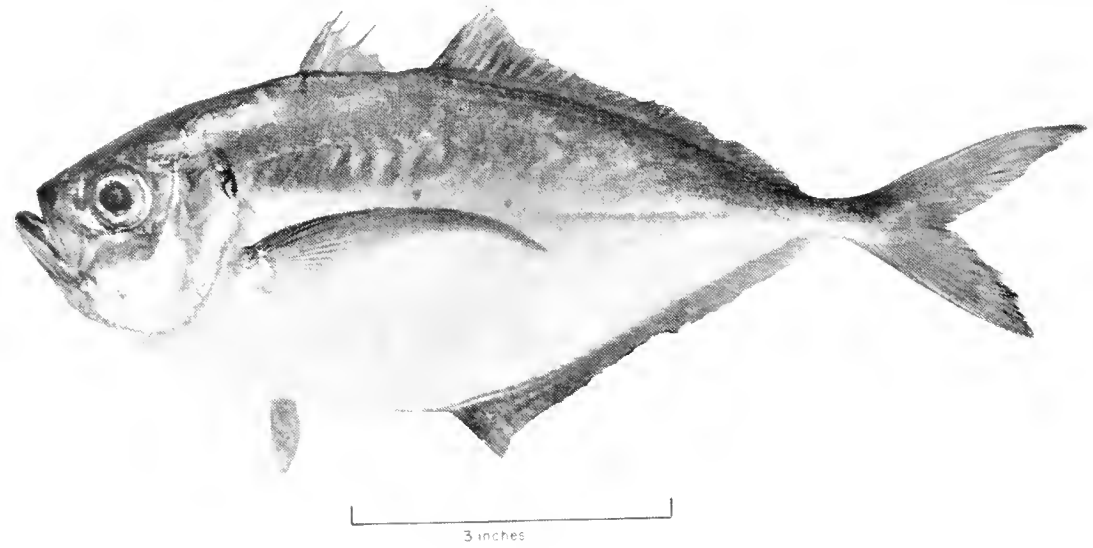

FIGURE 4. Yellowtail Jack, *Chloroscombrus orqueta*. Photograph by Hawthorne

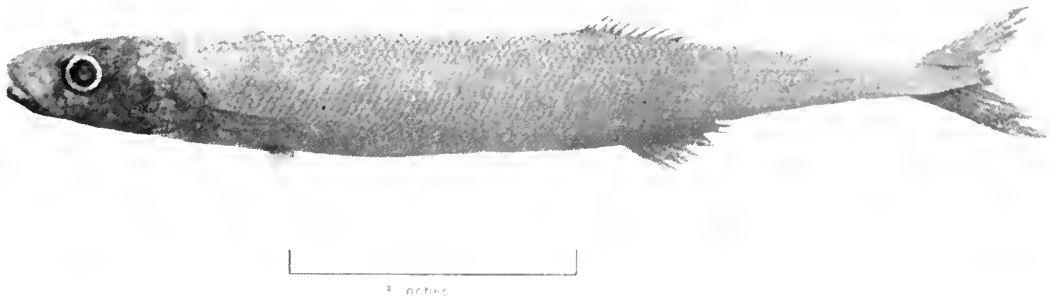

FIGURE 5. Squaretail, *Tetragonurus cuvieri*. Photograph by Al Johns for Vernon M. Haden, San Pedro

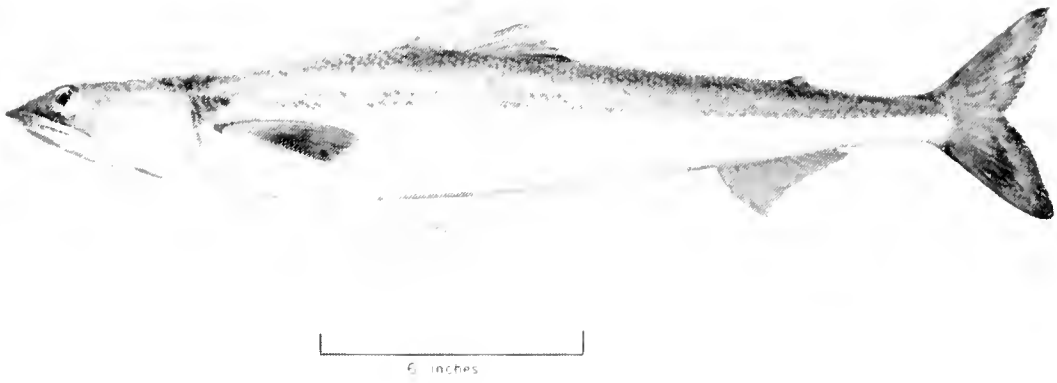

FIGURE 6. California Lizard Fish, *Synodus lucioceps*. Photograph by D. H. Fry, Jr.

FIGURE 7. Jack-crevally, *Caranax caninus*. Photograph by Al Johns for Vernon M. Haden, San Pedro

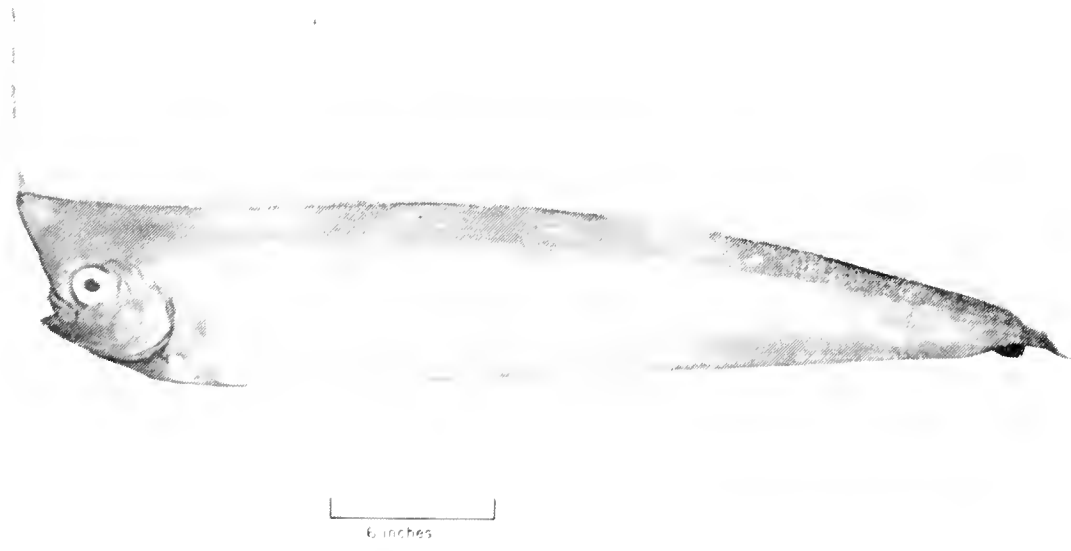

FIGURE 8. Oarfish, *Lophotus*. Photograph by Al Johns for Vernon M. Haden, San Pedro

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6—97131

FOOD HABITS OF THE RING-NECKED PHEASANT *(PHASIANUS COLCHICUS)* IN THE SACRAMENTO VALLEY, CALIFORNIA[1]

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INTRODUCTION

The California Division of Fish and Game is currently conducting a research program on the life history and management of the ring-necked pheasant. A knowledge of pheasant food habits is basic to understanding many phases of this work. This paper reports the results of a food habits study made during 1946.

The data is presented in two parts; the first deals with the food habits of the adult birds and the second with those of the immature birds or chicks.

For guidance and advice particular acknowledgment is due to Mr. Daniel Tillotson of the California Division of Fish and Game. Staff members of the Herbarium and of the Division of Entomology of the University of California aided in the identification of the food items.

DESCRIPTION OF THE STUDY AREA

General

The study area was comprised of approximately 500 square miles of what is considered the best pheasant habitat in California. Most of this area is located in the Sacramento Valley portion of Butte County, but adjoining valley portions of Glenn, Colusa, and Sutter Counties were included. The terrain is flat having an elevation of 60 feet above sea level in the lower central valley sections and sloping gradually to 150 feet in the eastern portion near the Sierra foothills.

Climate

The Sacramento Valley has long, hot, dry summers and mild rainy winters. Annual rainfall at points within the study area varies from 15 to 25 inches. The rainy season usually begins late in October and ends in March. Temperatures of 100° F. occur commonly during the summer months. Frosty mornings are common in winter but the day-time temperatures always rise above the freezing point. A growing season of 250 days or more prevails.

General Farming Practices

Most of the agriculture of the region is dependent upon irrigation during the summer growing season. A large available supply of water for this purpose combined with a long growing season and favorable soil conditions make possible the cultivation of a great variety of crops. Most

[1] Federal Aid in Wildlife Restoration Act, California Projects 25-R and 22-R.

important from the standpoint of providing food for pheasants are the various types of field crops produced. In Butte County approximately one-third of the total farm income derives from these crops. The 1946 percentage of the six major field crops grown in Butte County were as follows:

Rice	30.4
Barley	20.0
Wheat	14.3
Pasture clover	11.8
Alfalfa	6.0
Milo	5.5
Miscellaneous	12.0

Most important of the field crops is rice. As large concentrations of pheasants in California are commonly found associated with this crop it is evident that this region differs from most other parts of the pheasant range of the United States where pheasants are found most frequently associated with corn, wheat, or barley. However, in the rice growing districts interspersed fields of barley, wheat, alfalfa, miscellaneous crops, pasture, and uncultivated lands occur.

Rice Culture

The ground for rice culture usually is plowed in the spring as soon as possible, April in most years. Rice seeding is usually accomplished by broadcasting from an airplane, during May and is normally completed by the end of June. The crop matures in September and October at which time the fields are drained to allow drying of the ground so that equipment can be used in harvesting. About two weeks after draining the harvest begins, continuing throughout the fall, and usually is completed by mid-November. During dry periods in winter, it is common practice to burn off the rice stubble. Some fields are plowed immediately after burning in preparation for winter or spring planting of wheat or barley. Other fields may be left fallow a year between rice crops, or if rice is to be planted the next year plowing may be deferred until spring.

Due to the fact that rice culture is for the most part conducted on a large scale, some farms being as large as 7,000 acres, little or no effort is spent in attempting to "clean farm" the areas. This results in the borders and contour levees of the rice fields being covered with a profusion of numerous weed species. Moreover, the large amount of water required by rice, a crop that must be flooded during its entire growing season, necessitates numerous irrigation and drainage ditches with attendant small sloughs and marshy areas. These areas are allowed to become covered with thick weedy vegetation which creates an abundance of excellent pheasant cover (Figs. 9-12). At harvest time small strips of rice are missed and rice is left untouched along the edges of levees, drainage ditches, and boggy places. An abundance of shattered rice is to be found on the ground in the stubble and a considerable amount is spilled from trucks along the roads as the rice is being hauled to the storage warehouses.

FOOD HABITS OF ADULT PHEASANTS

Collecting and Analytical Procedures

Pheasants were collected by shooting in every month of the year so that seasonal changes in diet could be detected. When possible, collections

FIGURE 9. Appearance of typical rice field before start of growing season. Note curving rice checks which later become covered with dense growth of weeds such as barnyard grass, providing abundant food and cover for pheasants.

FIGURE 10. Appearance of rice field after harvest. Ground is now littered with waste rice grains, the mainstay in pheasant's diet. Cover is provided by rice checks and nearby strip of willows and cottonwoods.

FIGURE 11. Excellent pheasant range in winter aspect. Harvested rice field at left, with abundant waste rice grains, is adjacent to tule-filled drainage slough providing dense cover.

FIGURE 12. Willow thicket in irrigation ditch serves as good cover for pheasants which forage in nearby grain fields or in weeds alongside road and fencerow.

were made after the morning and evening feeding periods in order to insure well filled crops. In addition, road kills, mower kills and hunter kills were sources of material. Table 1 gives the number of crops collected per month. The relatively large number of crops collected in December was a result of the donation of crops by hunters.

TABLE 1—NUMBER OF PHEASANT CROPS COLLECTED

January	7	July	8
February	11	August	6
March	9	September	10
April	12	October	14
May	17	November	10
June	16	December	59
		Total	179

Only crops were used in the analyses. This insures a more accurate picture of the proportions of the different items in the diet of the birds than if both crops and gizzards were used. Reasons for this have been stated by Jensen and Korschgen (1947) in their experiments on bobwhite quail. It seems reasonable to assume that their conclusions would hold true for pheasants as well as for quail.

Upon opening the crops immediate separation was made of the seeds from the soft items such as leaves and insects. The seeds were then oven dried to drive off the excess moisture. Soft items were merely blotted dry of moisture. The quantity of each item was measured in a graduated cylinder by water displacement.

Data was summarized by use of the aggregate percentage method described by Martin, Gensch, and Brown (1946). Frequency of occurrence of each item was calculated on a yearly basis.

Results of the Analyses

All items comprising 5 percent or more of the diet during one or more months and the yearly frequency of occurrence for these items are shown in Table 2. Table 3 shows volume percent and yearly frequency of occurrence of the main food types. Fig. 13 graphically portrays the yearly diet. Table 6 (at end of paper) is a complete list of all plant species consumed by the pheasants examined during this study.

Cultivated Seed Crops

More than 56 percent of the yearly diet was derived from cultivated seed crops. Rice, the most important, was found in 61 percent of all crops examined and as 38.5 percent of the total volume of food consumed. Some rice was taken by the birds in every month of the year. However, consumption of this grain was greatest during the fall and winter months, October through February. Rice fell off as a part of the diet in March and remained relatively low until fall with the exception of May and June, the months of rice planting operations when a considerable amount of waste seed rice is available to the birds.

Reduction in the consumption of rice by the pheasants in March and April was due to several factors. Gradual reduction in the amount of available rice takes place due to burning off and plowing of the rice stubble. The combined use by pheasants, rodents and myriads of wintering small birds such as blackbirds and others reduces the amount of rice remaining after the harvest. Also at this time of year there is a gradual

TABLE 2

Volume percent of the items comprising 5 percent or more of the diet of adult pheasants during one or more months

Item	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year	Year freq. occ.*
Seeds—														
Annual blue grass (*Poa annua*)				11.6	0.1	trace							1.0	0.6
Wheat (*Triticum aestivum*)			17.6		0.1	6.3	13.3	6.2	0.1	16.3	9.8	2.5	6.2	8.4
Barley (*Hordeum vulgare*)		14.5	trace	0.5	17.2	9.7	38.4	1.4	10.8	8.5		17.0	9.9	23.4
Rye grasses (*Lolium* spp.)			0.3		6.9	7.4	19.8	17.4	0.2	0.1		1.7	4.5	17.9
Wild oats (*Avena* spp.)		4.8	0.4	trace	trace	2.8	8.5	5.9	2.2	6.2	8.9	1.5	3.4	12.3
Oats (*Avena sativa*)						7.3	2.6		7.8			0.8	1.5	3.9
Rice (*Oryza sativa*)	84.3	73.1	24.0	10.0	52.8	31.2	1.4	7.0	17.6	50.1	64.5	45.3	38.5	61.0
Barnyard grass (*Echinochloa crusgalli*)	0.8	1.2	53.3	13.9	trace	6.4	5.6	2.0	22.1	2.4	8.7	4.0	10.0	48.6
Johnson grass (*Sorghum halepense*)						1.7	trace		7.8				0.6	2.8
Milo, sudan, etc. (*Sorghum vulgare*)							trace	3.3				10.0	1.1	7.3
Chickweed (*Stellaria media*)				24.9	0.1							trace	2.1	5.0
Cranesbill (*Geranium* sp.)					5.0								0.4	2.8
Prickly lettuce (*Lactuca scariola*)								19.9	1.3	2.1	trace		1.9	4.5
Milk thistle (*Silybum marianum*)						11.2					trace	trace	0.9	2.8
Bull thistle (*Cirsium lanceolatum*)									15.0	0.8	0.7	0.2	1.4	4.5
Miscellaneous	trace	trace	1.9	9.1	5.2	3.3	trace	3.7	1.6	3.5	0.3	11.0	3.3	59.2
Totals	85.1	93.6	97.5	70.0	87.4	87.3	89.6	66.8	86.5	90.0	92.9	94.0	86.7	98.3
Fleshy fruits—														
Ground-cherry (*Physalis* sp.)		1.0						11.3	0.3	0.7		3.7	1.4	5.0
Miscellaneous					2.6							1.7	0.3	1.1
Totals		1.0			2.6			11.3	0.3	0.7		5.4	1.7	6.1
Flower buds, flowers—														
Mustards (*Brassica* spp.)				7.3	trace								0.6	2.8
Miscellaneous			0.2	3.5	trace	1.4	0.6	trace	0.1	0.5	0.4	trace	0.6	7.8
Totals			0.2	10.8	trace	1.4	0.6	trace	0.1	0.5	0.4	trace	1.2	12.9

Leafage—														
Clover (*Trifolium* spp.)		trace		6.9	0.8				trace			0.1	0.7	5.0
Cranebill (*Geranium* sp.)	6.3												0.5	0.6
Ground-cherry (*Physalis* sp.)							0.5	16.4		0.6			1.5	2.2
Sow thistles (*Sonchus* spp.)				0.1	trace			5.5					0.5	2.2
Miscellaneous	8.6	5.4	2.1	2.7	1.2	5.1	trace	trace	0.9	5.9	1.4	0.5	2.8	51.5
Totals	14.9	5.4	2.1	9.7	2.0	5.1	0.5	21.9	0.9	6.5	1.4	0.6	6.0	52.0
Corms and roots—														
Brodiaeas (*Brodiaea* spp.)							3.4		8.2				1.0	1.7
Miscellaneous										trace			trace	1.1
Totals							3.4		8.2	trace			1.0	2.2
Animal species—														
Grasshoppers (*Melanoplus* spp.)							5.3			2.2			0.6	2.2
Miscellaneous	trace	trace	0.2	9.5	8.0	6.2	0.6	trace	4.0	0.1	5.3	trace	2.8	39.7
Totals	trace	trace	0.2	9.5	8.0	6.2	5.9	trace	4.0	2.3	5.3	trace	3.4	41.5

* Frequency of occurrence on a yearly basis.

TABLE 3

Volume percent of the main food items eaten by adult pheasants by month and year

Item	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year	Year freq. occ.*
Rice	84.3	75.1	24.9	10.0	52.8	31.2	1.4	7.0	17.6	50.1	64.5	45.3	38.5	61.0
Other cultivated seeds		14.5	17.6	0.5	17.3	23.5	54.3	10.9	18.7	24.8	9.8	33.7	18.3	30.7
Wild or weed seeds	0.8	6.9	55.9	50.5	17.3	24.5	33.9	48.9	50.2	15.1	18.6	15.0	24.9	84.5
Fleshy fruits		4.0			2.6			11.3	0.3	0.7		5.4	1.7	6.1
Flower buds, flowers			0.2	10.8	trace	1.4	0.6	trace	0.1	0.5	0.4	trace	1.2	12.9
Leafage	14.9	5.4	2.1	9.7	2.9	5.1	0.5	21.9	0.9	6.5	1.4	0.6	6.0	52.0
Corms, roots							3.4		8.2	trace			1.0	2.2
Animal species	trace	trace	0.2	9.5	8.0	6.2	5.9	trace	4.0	2.3	5.3	trace	3.4	41.5

* Frequency of occurrence on a yearly basis.

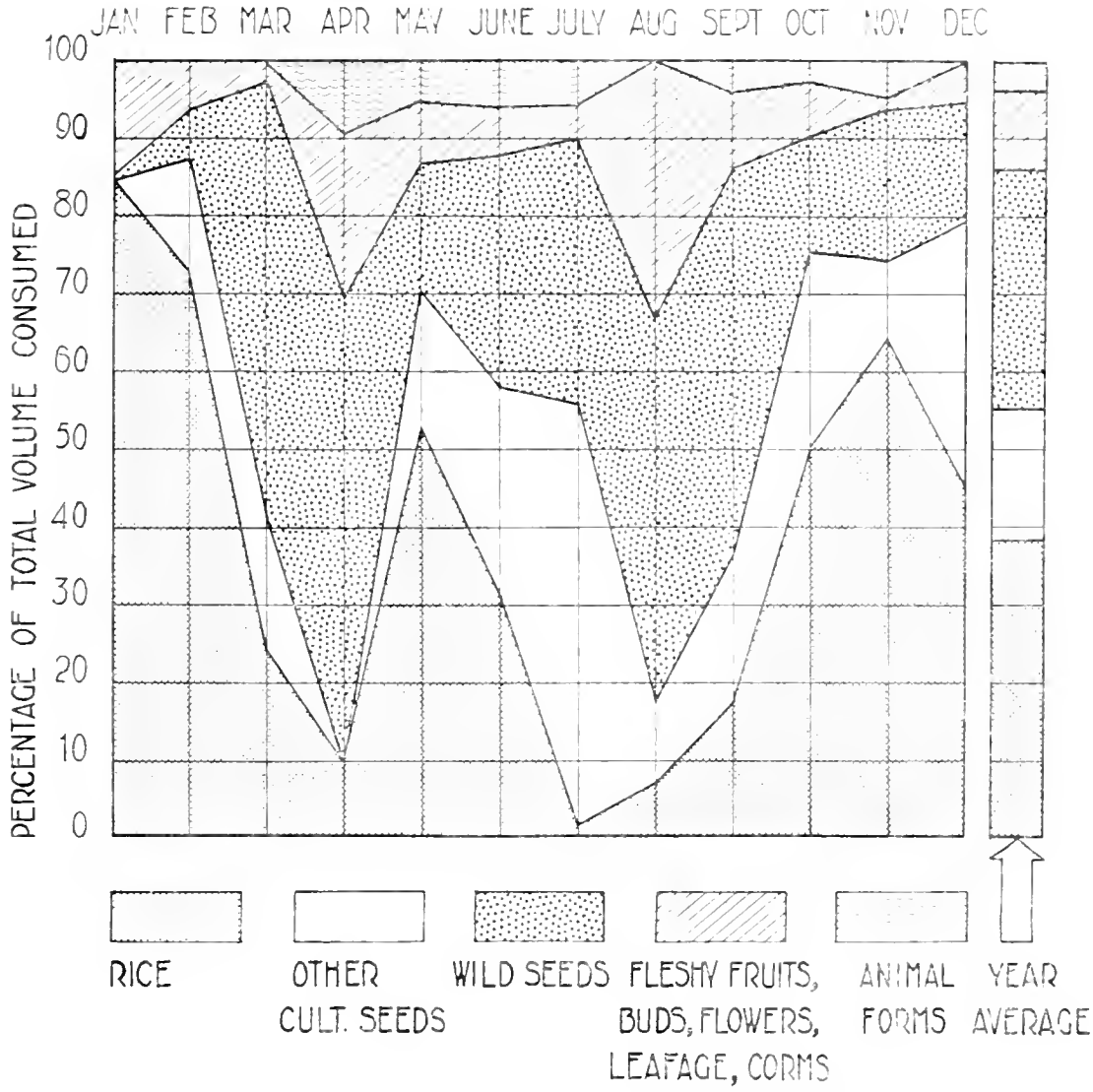

FIGURE 13. Monthly food consumption by adult pheasants.

movement of the birds from the rice areas to areas more suitable for nesting which reduces the consumption of rice. Reduction in the use of rice during the months of July, August and September is due to the fact that the maturing rice fields are flooded and waste seeds are unavailable.

Barley and wheat were the other grain crops important in the diet of pheasants in the study area. One or both of these grains were taken in every month, except January. Maximum consumption was in July when these two grains combined to make up 51.7 percent of the total volume of food. This coincided with the end of the harvesting season.

Oats and the grain sorghums (milo, Sudan grass, etc.) were relatively unimportant to pheasants in the study area; their combined use amounted to less than 3 percent of the years total by volume. This was to be expected as these crops were not so extensively planted in the study area as the other grains mentioned.

Wild Seeds

Wild, or weed seeds, were taken throughout the year, making up nearly 30 percent by volume of the yearly diet. During spring, summer

and early fall when the utilization of cultivated seeds was lowest, weed seeds were utilized the most (see Fig. 13 and Table 3).

Outstanding in importance of the weed seeds in the diet of pheasants from the study area was water grass (*Echinochloa crusgalli*). It is extremely abundant in the rice fields and away from the rice wherever moist conditions prevail. Seeding is most abundant in August and September just prior to the harvesting of rice. Ten percent of the yearly diet of the birds was made up of the seeds of this grass, which made it the second most important of all the foods taken by pheasants in the study area.

The rye grasses (*Lolium* spp.) and the wild oats (*Avena* spp.) were important to the birds, and were utilized mainly during the summer months. These grasses are to be found in abundance in pastures, along ditches and roads, and as weeds in wheat and barley fields.

In April and May seeds of certain early maturing annuals contributed to the diet. Chief of these were annual blue grass (*Poa annua*), chick weed (*Stellaria media*), and cranesbill (*Geranium* spp.).

In early summer the milk thistle (*Silybum marianum*) matures and during June its seeds comprise 11.2 percent of the diet. During August the seeds of prickly lettuce (*Lactuca scariola*) made up 19.9 percent. Bull thistle (*Cirsium lanceolatum*) made up 15 per cent of the diet in September. The last two mentioned weeds mature in late summer, and are abundant in fallow fields, along ditches and waste places.

Leafage

Leafage made up 6 percent of the total yearly food, and was found to occur in 52 percent of all crops examined. Furthermore, utilization of this type of food throughout the year remains relatively even from month to month. It has been suggested that this food is necessary in furnishing special elements to the diet and that small amounts taken often satisfy this need. Table 2 shows the species that ranked high in importance. The leaves of grass although never making up 5 percent of the diet in any month were found in 30.2 percent of all crops examined.

Corms and Roots

Corms and roots made up 1 percent of the yearly diet. Corms of the Brodiaeas (*Brodiaea* spp.) were the only ones taken in significant amounts. These corms are often brought to the surface of the ground by plowing operations and are thus made available to the birds.

Fleshy Fruits

This type of food contributed little to the diet of pheasants from the study area, and amounted to 1.7 percent of the year's total food. The only fleshy fruits taken consistently were the fruits of the ground cherries (*Physalis* spp.). The fruit of the ground cherries mature in the summer but the plants with their ripened fruits persist into the fall and winter. As a result they were taken from August through February.

Flower Buds and Flowers

Buds and flowers amounted to 1.2 percent of the pheasants' yearly food consumption. Many varieties were taken but the buds and flowers of the mustards (*Brassica* spp.) were the only ones taken in an amount of 5 percent or more in any one month. In April they made up 7.3 percent

of the diet. Except for January and February small amounts of buds and flowers were taken throughout the year.

Animal species

Three and four-tenths percent of the adult pheasant diet was made up of animal species and 41.5 percent of all crops examined contained this food. The frequency with which this type of food is taken, even though in small volume, may be an indication that it is essential to the dietary requirements of the birds. Grasshoppers (*Melanoplus* spp.) comprised 5.3 percent of the diet in July. Animal species taken were predominantly insects, and these were consumed in large variety. For a complete summary of animal species taken see the taxonomic list, Table 7, at the end of this paper.

Feeding differences between individuals

Extreme variation may exist in the kinds of food taken by individual pheasants of the same sex and age, when foraging at the same time and same location. Two adult hens were collected within 45 minutes of each other at the same location in January, and the crop of one contained 100 percent of leafage while that of the other contained five percent leafage and 95 percent rice and water grass seed.

Pheasants may consume one or many items during any one feeding period. Number of items found in single full crops varied from one to 26.

Non-food item—grit

Crops from forty of the 179 adults examined in this study showed that 35 contained no grit, four contained traces, and one contained 8 percent of the total crop contents as grit. Forty gizzards from the same birds were examined and all found to contain grit. The average amount of grit per gizzard was 1.7 cc. (extremes 0.2 cc. and 4.5 cc.) or 19.4 percent of the total gizzard contents. This indicates that this type of material accumulates in the gizzards from the normally small amount taken at any one feeding period.

FOOD HABITS OF PHEASANT CHICKS

Collecting and analytical procedures

Chick crops and gizzards were collected during the months of May through August, a four month's period. Birds killed during hay mowing operations and along roads furnished most of the material for the analyses. However, some of the birds 13 and 16 weeks of age were collected by shooting. Table 4 shows the number of crops and gizzards obtained for each age group. The age of the chicks was determined by the method described by Buss (1946). The technique of analysis was the same as that described for adults. However, because of the small number of samples both crops and gizzards were used in the analyses of chick food habits.

Results of the Analyses

Table 5 gives the volume percent of each item in the diet which occurred a minimum of 5 percent in one or more age groups. Figure 14 graphically shows the proportions of animal to plant food taken by chicks and the proportion of animal and plant food in the diet of the adults taken during the same period.

TABLE 4

Distribution of samples from pheasant chicks

	1 wk.	2 wks.	3 wks.	4 wks.	5 wks.	6 wks.	7 wks.	8 wks.	9 wks.	10 wks.	11-12 wks.	13-16 wks	Total
Crops	0	0	2	2	2	3	2	0	0	6	7	11	35
Gizzards	5	11	4	2	4	4	4	5	7	2	1	1	50
Totals	5	11	6	4	6	7	6	5	7	8	8	12	85

Plant foods in the Chick Diet

Seeds occurred in significant volume in the diet after the first week of life. Such large seeds as cultivated peas were found in the gizzard of a two-weeks old bird, and wheat, barley, and oats were consumed by birds three weeks and older. Fleshy fruits, flower buds and flowers were of negligible importance in the chick diet. Green leafage, found as a trace in the one-week age group, did not appear in measurable amount until the eight-week age group. Nine-week old chicks consumed leafage to the amount of 13.1 percent of the volume of their diet, which was the highest figure for this type of food.

Cultivated grain crops, especially barley and wheat, were important to the chicks as well as the adults. In seven of the ten age groups three weeks of age and older, cultivated grains comprised over half of the total plant food consumed.

Generally speaking the same wild seeds that occurred prominently in the diet of adults were prominent in the diet of chicks. A notable exception was the seeds of lupines (*Lupinus* spp.), which comprised 1 percent or more of the diet of four age groups.

Animal Food in the Diet of Chicks

In chicks of the one-week age group insect material accounted for almost the entire food items in their gizzards; only traces of seeds were found. An examination of Figure 14 shows that generally as the chicks grow older their consumption of animal food grows less, until at the age of 13 to 16 weeks their diet becomes similar to that of adults collected at the same time. It is felt that a larger sample would have probably produced a smoother curve than Figure 14. The volume of animal food in the diet exceeded 50 percent of the total volume in all age groups up to and including the eight-week group except one, the five-week group. Furthermore, animal species occurred in the crops and gizzards of all birds up to and including the ten-week age group except for one crop in the six-week group, this particular chick having only wheat in its crop.

Small beetles were the chief fare of the chicks up to two weeks of age. Later in life larger insects such as grasshoppers figured prominently in the diet.

The finely ground condition of much of the insect food in the gizzards of the chicks examined necessitated assigning much of the animal material to the miscellaneous column in Table 5.

Non-food Item—Grit

Early in life pheasants utilize grit. The five gizzards examined from birds known to be no older than one week all contained this material.

TABLE 5

Volume percent of the items comprising a minimum of 5 percent of the pheasant chick diet in one or more age groups

(Chick Age in Weeks)

Item	1 week	2 weeks	3 weeks	4 weeks	5 weeks	6 weeks	7 weeks	8 weeks	9 weeks	10 weeks	11-12 weeks	13-16 weeks
Seeds—												
Barley or oats (Gramineae)			18.6		20.0							
Wheat (*Triticum aestivum*)					35.8	14.3				24.1		2.4
Barley (*Hordeum vulgare*)				20.0		11.1	14.6	26.0	34.4	14.5	7.8	33.3
Rye grasses (*Lolium* spp.)		9.1			1.2					15.1		11.4
Wild oats (*Avena fatua*)										1.4	45.3	1.1
Cultivated oats (*Avena sativa*)												8.5
Barnyard grass (*Echinochloa crusgalli*)										4.3	6.3	7.9
Miner's lettuce (*Montia perfoliata*)						2.4	18.1	4.3	3.5	2.1		
Lupine (*Lupinus* spp.)		2.3				10.4	1.0	3.6				
Field pea (*Pisum sativum*)		9.1										
Prickly lettuce (*Lactuca scariola*)											9.6	1.2
Yellow star thistle (*Centaurea solstitialis*)												14.1
Miscellaneous	trace	2.3	trace	trace	trace	trace	trace	1.8	2.4	10.2	trace	4.9
Totals	trace	22.8	18.6	20.0	57.0	38.2	33.7	35.7	40.3	71.7	69.0	84.8
Fleshy fruits—												
Totals												1.6
Flower buds, flowers—												
Totals											1.0	1.0
Leafage—												
Totals	trace	trace				trace		9.0	13.1	6.2	trace	9.3
Animal species—												
Grasshoppers, locusts (Locustidae)			6.7			22.4	7.0	24.3	26.8	8.1	27.8	
Grasshopper nymphs (Locustidae)			10.0	12.5		3.3	8.3					
Dragonflies (Anisoptera)					1.1					12.5		
Buffalo treehopper (*Ceresa bubalis*)						7.2	8.3		1.2			
Plant bug (*Lygus* sp.)						7.2	1.4					
Predaceous ground beetles (Carabidae)	22.2											
Carrion beetles (Silphidae)				17.0					1.1			
Clover root curculio (*Sitona* sp.)	22.2	9.4										
Clover leaf weevil (*Hypera* sp.)	11.1	30.6		12.5					2.2			
Measuring worms (Geometridae—larvae)			8.6			6.9						
Miscellaneous	44.5	37.2	56.1	38.0	41.9	14.8	41.3	31.0	15.3	1.5	2.2	3.3
Totals	100.0	77.2	81.4	80.0	43.0	61.8	66.3	55.3	46.6	22.1	30.0	3.3

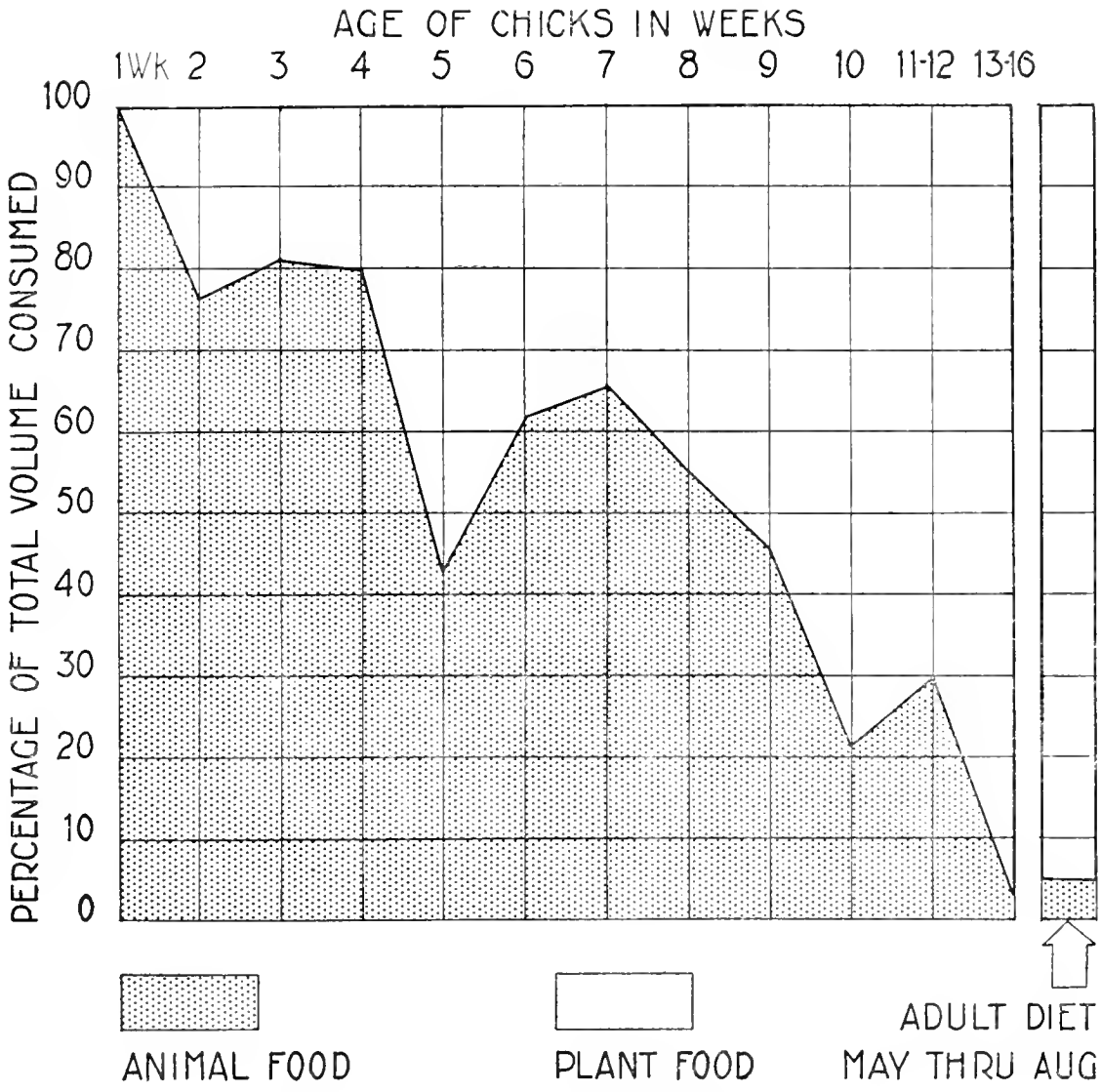

FIGURE 14. Food consumption in pheasant chicks.

Three had it as a trace, one as 0.1 cc. or 25 percent of the total contents, and the other as 0.1 cc. or 100 percent of the total contents, with traces of animal food present. In the gizzards of practically all chicks three weeks of age and older grit figures as a significant part of the contents.

ECONOMIC ASPECTS OF PHEASANT FOOD HABITS

Pheasant damage to the principal grain crops grown in the Sacramento Valley is negligible. Although rice, barley and wheat make up the major portion of the pheasant diet in the study area only a very small portion of the total is taken from unharvested crops. Heaviest use of grains by the birds takes place in the fall and winter after harvest.

It should be pointed out that much crop damage attributed to pheasants when fully investigated may often be the result of depredation by other species. Workers in other states, Hicks (1936), Dalke (1937), Hiatt (1946), and others have reported this to be so. Investigation of a damage complaint concerning young sugar beet plants near Chico, Butte County, California, revealed that the depredation was caused by sparrows, blackbirds and quail. In fact, pheasants were rare in the immediate vicinity.

However, pheasant damage to melon and tomato crops grown in the study area may be considerable. At present these crops are not extensive.

SUMMARY

Part of the research program of the California Division of Fish and Game on the life history and management of the ring-necked pheasant in California was conducted in the Sacramento Valley, including parts of Butte, Colusa, Glenn and Sutter Counties. The climate is characterized by hot, dry summers and mild, rainy winters. Most of the crops grown in the area are dependent upon irrigation; the major crop is rice; barley and wheat are also important.

Cultivated seed crops made up nearly 57 percent of the total yearly diet of adult pheasants and rice was the most important single item in the diet. Wild or weed seeds accounted for nearly 30 percent of the yearly diet, of which barnyard grass was the most important single species. Fleshy fruits, flower buds, flowers, corms and roots were of minor importance to pheasants in the study area. Leafage and animal species were taken in small volume by adults, but leafage was found in 52 percent and animal species in 41.5 percent of all adult crops examined. Consumption of animal food was much greater for chicks than for adults and was greatest in the first week of life, declining gradually until the end of the twelfth week. Birds older than 12 weeks apparently consume animal food in amounts similar to that taken by adults. Grit is utilized by pheasants from the first week of life.

Crop damage is negligible in the grain growing areas. Most grain consumed is waste.

TABLE 6—TAXONOMIC LIST OF PLANT SPECIES IN FOOD OF PHEASANTS IN THE SACRAMENTO VALLEY

This list presents the families, genera and species of plants involved in the diet of pheasants studied, together with the common names of the plants and portions consumed.

MARSILEACEAE—Marsilea family
(*Marsilea vestita*) Clover fern, sporocarps, leaves
TYPHACEAE—Cattail family
(*Typha* sp.) Cattail, seeds, leaves
NAIADACEAE—Pondweed family
(*Naias quadalupensis*) Naiad, nutlets
(*Naias* sp.) Naiad, nutlets
ALISMACEAE—Water plantain family
(*Alisma plantago*) Water plantain, achenes, leaves
(*Echinodorus cordifolius*) Burhead, achenes
GRAMINEAE—Grass family
(*Bromus rigidus*) "Ripgut" grass, seeds
(*Bromus* sp.) Brome grass, seeds
(*Festuca myuros*) Rats'-tail fescue, florets
(*Poa annua*) Annual blue grass, florets
(*Triticum aestivum*) Cultivated wheat seeds
(*Hordeum vulgare*) Cultivated barley, seeds
(*Lolium multiflorum*) Italian ryegrass, florets
(*Lolium temulentum*) Darnel, florets
(*Lepturus cylindricus*) Thintail, florets
(*Avena fatua*) Wild oats, florets
(*Avena sativa*) Cultivated oats, seeds
(*Alopecurus carolinianus*) Foxtail, florets
(*Polypogon monspeliensis*) Rabbitfoot grass, florets
(*Sporobolus* sp.) Dropseed, seeds
(*Phalaris paradoxa*) Gnawed canary grass, florets
(*Phalaris brachystachys*) Short-spiked canary grass, florets
(*Phalaris minor*) Mediterranean canary grass, florets
(*Phalaris lemmoni*) Canary grass, florets
(*Oryza sativa*) Cultivated rice seeds

TABLE 6—TAXONOMIC LIST OF PLANT SPECIES IN FOOD OF PHEASANTS IN THE SACRAMENTO VALLEY—Continued

GRAMINEAE—Grass family (Continued)
(*Echinochloa crusgalli*) Barnyard grass, seeds
(*Setaria* sp.) Bristlegrass, seeds
(*Sorghum halepense*) Johnson grass, seeds
(*Sorghum vulgare*) Milo, Sudan grass, etc., seeds
Gramineae (spp.) Seeds, leaves
CYPERACEAE—Sedge family
(*Cyperus esculentus*) Chufa, tubers, achenes
(*Cyperus virens*) Galingale, achenes
(*Eleocharis palustris*) Spike rush, achenes
(*Eleocharis obtusa*) Spike rush, achenes
(*Scirpus acutus*) Common tule, achenes
(*Scirpus paludosus*) Bulrush, achenes
(*Scirpus* spp.) Bulrush, achenes
JUNCACEAE—Rush family
(*Juncus* sp.) Seeds, leafage
LILIACEAE—Lily family
(*Brodiaea* sp.) Brodiaea, corms
IRIDACEAE—Iris family
(*Sisyrinchium bellum*) Blue-eyes grass, seed pods
FAGACEAE—Oak family
(*Quercus lobata*) Valley oak, acorn fragments
POLYGONACEAE—Buckwheat family
(*Polygonum lapathifolium*) Common knotweed, achenes
(*Polygonum aviculare*) Wiregrass, achenes
(*Polygonum* spp.) Knotweed, achenes, leaves
(*Rumex* spp.) Dock achenes
AMARANTHACEAE—Amaranth family
(*Amaranthus retroflexus*) Rough pigweed, seeds
(*Amaranthus graecizans*) Tumbleweed, seeds
(*Amaranthus* sp.) Seeds
PORTULACACEAE—Purslane family
(*Calandrinia caulescens*) Red Maids, seeds
(*Montia perfoliata*) Miner's lettuce, seeds
(*Portulaca oleracea*) Portulaca leaves
CARYOPHYLLACEAE—Pink family
(*Stellaria media*) Chickweed, seeds
RANUNCULACEAE—Buttercup family
(*Ranunculus* sp.) Buttercup, achenes
PAPAVERACEAE—Poppy family
(*Eschscholtzia californica*) California poppy, flower buds
CRUCIFERAE—Mustard family
(*Brassica campestris*) Yellow mustard, leaves, flower buds
(*Brassica arvensis*) Wild mustard, leaves, flower buds, seeds
(*Brassica nigra*) Black mustard, leaves, flower buds
ROSACEAE—Rose family
(*Prunus amygdalus*) Almond, kernels
(*Prunus* sp.) Cultivated prune, fruit
(*Rubus* sp.) Blackberry, berries
LEGUMINOSAE—Pea family
(*Lupinus* sp.) Lupine, leaves, seeds
(*Medicago sativa*) Alfalfa, seed pods, leaves
(*Medicago hispida*) Bur clover, seed pods, leaves
(*Melilotus indica*) Yellow sweet clover, seeds
(*Melilotus alba*) White sweet clover, seeds
(*Trifolium* spp.) Clover, seeds, leaves
(*Lotus* sp.) Lotus, seeds
(*Vicia sativa*) Vetch, seeds
(*Vicia* sp.) Vetch, leaves
Leguminosae (sp.) Seeds
GERANIACEAE—Geranium family
(*Geranium* sp.) Cranesbill, seeds, leaves
(*Erodium botrys*) Broadleaf filaree, seeds
EUPHORBIACEAE—Spurge family
(*Eremocarpus setigerus*) Turkey mullein, seeds
VITACEAE—Vine family
(*Vitus californica*) California wild grape, fruits, seeds
(*Vitis* sp.) Grape, seeds
LYTHRACEAE—Loose-strife family
(*Ammannia coccinea*) Red stem, seeds
ONAGRACEAE—Evening Primrose family
(*Epilobium paniculatum*) Panicled willow-herb, seeds, leaves
UMBELLIFERAE—Parsley family
Umbelliferae (sp.) Seeds
CONVOLVULACEAE—Morning-glory family
(*Convolvulus arvensis*) Wild morning-glory, seeds, leaves
POLEMONIACEAE—Gilia family
(*Navarretia* sp.) Navarretia, seeds
BORAGINACEAE—Borage family
Boraginaceae (sp.) Seeds
VERBENACEAE—Verbena family
(*Lippia nodiflora*) Mat-grass, leaves, stems
LABIATAE—Mint family
(*Stachys ajugoides*) Hedge nettle, seeds, leaves

TABLE 6—TAXONOMIC LIST OF PLANT SPECIES IN FOOD OF PHEASANTS IN THE SACRAMENTO VALLEY—Continued

LABIATAE—Mint family (Continued)
(*Lycopus americanus*) Water horehound, seeds
(*Lycopus lucidus*) Water horehound, leaves
SOLANACEAE—Nightshade family
(*Physalis* sp.) Ground-cherry, seeds, fruits, leaves
SCROPHULARIACEAE—Figwort family
(*Verbascum* sp.) Mullein, seeds
(*Collinsia* sp.)
(*Mimulus guttatus*) Monkey flower, seed capsules
(*Veronica* sp.) Speedwell, seeds
COMPOSITAE—Sunflower family
(*Lactuca scariola*) Prickly lettuce, achenes, leaves, flower buds
(*Sonchus* spp.) Sow thistles, achenes, flower buds, leaves
(*Cichoriae* sp.) Seeds
(*Aster exilis*) Slender aster, achenes, flower buds
(*Helianthus annuus*) Common sunflower, achenes
(*Bidens frondosa*) Beggarticks, achenes
(*Athemis cotula*) Mayweed, leaves
(*Silybum marianum*) Milk thistle, achenes
(*Cirsium lanceolatum*) Bull thistle, achenes, leaves
(*Centaurea solstitialis*) Yellow star thistle, achenes
Compositae (spp.) Achenes

TABLE 7. TAXONOMIC LIST OF ANIMAL SPECIES IN FOOD OF PHEASANTS, IN THE SACRAMENTO VALLEY, CALIFORNIA

Order Ascaroidea, Round worm
Mermithidae
Mermis sp.
Order Pulmonata
Gyraulus sp., Freshwater snail
Fossaria sp., Freshwater snail
Slug (sp.)
Order Isopoda
Oniscidae, Pill bugs, sow bugs, wood lice
Armadillidium vulgare, Pillbug
Oniscidae (sp.)
Order Decapoda
Atyidae, Freshwater shrimps
Unident Atyidae
Class Diplopoda Millipedes
Unidentified Millipede
Class Chilopoda, Centipedes
Centipede (sp.)
Class Arachnida
Order Araneida Spiders
Lycosidae (sp.) Hunting spiders
Spiders (spp.)
Order Acarina
Erythraeidae
Erythroeus sp., Red Mite
Class Insecta, Insects
Order Thysanura, Silver fish
Thysanuran (sp.)
Order Orthoptera
Locustidae, Locusts, Grasshoppers
Trimerotropis sp., Band-winged locust
Melanoplus differentialis, Differential locust, adults, nymphs
Melanoplus devastator, Devastating grasshopper, adults, nymphs
Melanoplus sp., Grasshopper, adults, nymphs
Locustidae (sp.)
Tettigoniidae, Long-horned grasshoppers, katydids
Microcentrum rhombifolium, Angular-winged katydid, eggs
Conocephalus fasciatus, Slender meadow grasshopper
Tettigoniidae (sp.)
Stenopelmatidae
Stenopelmatus longispina, Jerusalem cricket
Gryllidae
Cryllus assimilis, Field cricket
Oecanthus sp., Tree cricket
Order Embiidina
Embia californica, California embiid
Order Ephemerida
Ephemeridan (sp.), Mayfly
Order Odonata
Coenagrionidae, Stalked-winged damsel flies
Enallagma (sp.)
Unidentified sp.
Agrionidae (sp.), Damsel flies
Aeschnidae (sp.), Large Dragonflies
Libellulidae Skimmers
Sympetrum corruptum
Order Neuroptera
Raphidiidae, Snake flies
Raphidiidae (sp.), Larvae
Chrysopidae (sp.), Green lace wings, Larvae
Order Homoptera
Cicadidae (sp.), Cicadas
Cercopidae (sp.), Spittle bugs
Membracidae
Ceresa bubalis, Buffalo tree hopper
Stictocephala festina, Three-cornered Alfalfa hopper

TABLE 7. TAXONOMIC LIST OF ANIMAL SPECIES IN FOOD OF PHEASANTS, IN THE SACRAMENTO VALLEY, CALIFORNIA—Continued

Order Homoptera (Continued)
- Cicadellidae Leaf hoppers
  - *Gypona sp.*
  - Cicadellidae (sp.)
- Fulgoridae
  - *Cixius* sp., Fulgorid
- Aphididae (sp.), Aphis
- Coccidae sp., Mealy bugs, scales

Order Hemiptera
- Scutelleridae
  - *Eurygaster alternatus*, Alternate shield bug
- Cydnidae
  - *Thyreocaris extensus*, Common negro bug
- Pentatomidae
  - *Euschistus* sp., Stink bug
  - *Acrosternum hilaris*, Green soldier bug
- Coreidae (sp.), Squash bugs
- Lygaeidae (sp.), Chinch bugs, plant bugs
- Pyrrhocoridae
  - *Eurygopthalmus convivus* Bordered plant bug, nymph
- Tingidae (sp.), Lace bugs, Tingids
- Reduviidae, Assassin bugs
  - *Rasahus thoracicus*, Western corsair
  - *Empicoris* (sp.)
  - Reduviidae (sp.)
- Nabidae
  - *Nabis ferus*, Damsel bug
- Miridae
  - *Lygus pratensis*, Tarnished plant bug
  - *Lygus* sp.
- Veliidae
  - *Microvelia americana*, American veliid
  - Unidentified Hemiptera

Order Coleoptera
- Carabidae, Predaceous ground beetle
  - *Calosoma cancellatum*
  - *Anisodactylus* sp.
  - *Bembidium* sp.
  - Carabidae (sp.)
- Dytiscidae, Predaceous water beetles
  - *Cybister explanatus*
  - *Laccophilus* sp.
  - Hydrophilidae, Water scavenger beetles
  - *Tropisternus lateralis*
  - *Enochrus* sp.
- Silphidae, Carrion beetles
  - *Silpha ramosa*
- Staphylinidae (sp.), Rove beetles
- Lycidae (sp.), Net-winged beetles
- Melyridae, Soft-winged flower beetles
  - *Collops bipunctatus*, Two-spotted collops
  - Melyridae (sp.)
- Anthiscidae, Ant-like flower beetles
  - *Anthicus* sp.
- Elateridae, Click beetles
  - *Drasterius livens*
  - *Drasterius* sp.
  - *Ludius* (sp.), Wire worm
  - *Dolopius* (sp.), Potato wire worm
  - (*Anchastus* sp.)
  - Elateridae (sp.)
- Buprestidae
  - *Buprestis* sp., Buprestid
- Tenebrionidae, Darkling Ground beetles
  - *Metoponium* sp.
  - *Blapstinus* sp.
  - *Eleodes* sp.
  - *Tenebrio* sp., Yellow meal worm
- Scarabaeidae, June beetles
  - *Aphodius* sp.
  - Scarabaeidae (sp.)
- Chrysomelidae
  - *Diabrotica* sp., Cucumber beetle
  - *Gastroidea syanea*
  - *Pachybrachys hybridus*
  - Chrysomelidae (sp.)
- Curculionidae, Weevils
  - Rhynchitinae (sp.), Tooth-nose snout beetle
  - Otiorhynchinae (sp.), Scarred snout weevil
  - *Sitona hispidulus*, Clover root curculio
  - *Hypera punctata*, Clover leaf weevil
  - Calandrinae (sp.), Bill bugs
  - *Sphenophorus* sp., Tule billbug

Order Diptera
- Tipulidae (sp.), Crane flies
- Stratiomyiidae (sp.), Soldier flies
- Coenomyiidae (sp.)
- Syrphidae (sp.), Sweat flies, drone flies
- Muscidae (spp.), Flies, larvae, and pupae

Order Lepidoptera
- Pieridae, Sulphur and white butterflies (*Pieris* sp.) Cabbage worm

TABLE 7. TAXONOMIC LIST OF ANIMAL SPECIES IN FOOD OF PHEASANTS, IN THE SACRAMENTO VALLEY, CALIFORNIA—Continued

Order Lepidoptera (Continued)
Pieridae (sp.)
Sphingidae (sp.), Sphinx moths, larvae
Noctuidae (sp.), Cutworms, millers, larvae
Geometridae (spp.), Loopers, measuring worms, larvae
Order Hymenoptera
Braconidae (sp.), Braconid flies
Chalcididae (sp.), Chalcid flies
Formicidae spp.), Ants
Chrysididae (sp.), Wasps
Sphecidae (sp.), Thread-waisted wasps
Vespidae
Vespula pennsylvanica, Yellow jacket
Vespidae (spp.)
Halictidae (sp.), Sweat bees
Anthophoridae (sp.), Anthophorid bees
Apidae
Apis mellifica, Honeybee
Class Aves
Phasianus colchicus, Egg shell
Order Rodentia
Microtis californicus, Skull and tooth fragments

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REVIEWS

Woodcock Ways

By Henry M. Hall. New York, Oxford University Press, 1946. 84 pp., 8 col. pls., 9 black and white drawings. $6.50.

This exquisitely executed book is primarily intended for the sportsman, particularly that person desirous of adding to his game species library.

The idiosyncrasies of the "timber doodle" are little known to the native westerner and this book well describes the erratic mannerisms of this nocturnal shorebird which is prized by many shotgun enthusiasts of the eastern and mid-western United States and Canada. Hall is to be complimented on writing a book which portrays habits and habitat as personally observed and, at the same time, deprecates false beliefs such as the lunar effect on migratory flights. The ways and means of gunning for this game bird are so well described that a beginning woodcock hunter will profit from a serious study of the text. The problem of the continuance of an open season is discussed and sound management practices are proposed.

Ralph Ray's full color plates and drawings artistically and accurately depict woodcock attitudes and habitat, complementing Hall's varied field experiences, although restricted mainly to the states of New York and New Jersey.

Sufficient life history details are introduced to remove this book from the hunting adventure category although not sufficient to classify it as a serious ornithological study. However, the ornithologist will find that the interesting text makes for profitable recreational reading.—*Henry A. Hjersman, California Division of Fish and Game.*

Spinning for American Game Fish

By Joseph D. Bates, Jr., Boston, Little, Brown & Company, 1947 (reprinted, 1948). 247 pp., 54 illustrations, including 16 pp. of half tones and 2 color plates. $4.00.

It is a pleasure to read and study Colonel Bates' *Spinning for American Game Fish*. It is written by a sportsman-angler acquainted with a new and pleasurable type of fishing tackle. Too many sports books are written by men interested only in glory and financial gains, and without a thorough knowledge of their subject; this cannot be said of Bates.

As this type of angling is rather new in the United States (introduced from Europe about 1932), the author defines and qualifies the term by stating, "The science of spinning is fishing with a light lure and a thread line on a fixed spool reel"; and, "Since spinning (bladed) lures are employed in it, to a great extent, and since the line spins from the reel, it is more popularly known in America as 'spinning.'"

Fifteen chapters are divided into three parts. Part I, Background of Spinning, deals with a comprehensive history, limitations and opening remarks on the tackle. Part II, Equipment and Technique, is a "must read" for anglers who contemplate the purchase of spinning tackle; it will avoid many disappointments and will put thorough pleasure into fishing. Under the above heading the various component parts of the tackle are discussed, and techniques for the efficient use are pointed out. Part III, Fishing With Spinning Tackle, is a masterpiece of instructions for angling on stream, lake and ocean; the experience of Bates, as an accomplished angler, is passed on to the reader.

Throughout the book the adaptations, use and limitations are brought out in an easily read, clear and logical manner. A reader also notices the philosophical theme of conservation and sportsmanship—a worthy idea for any publication on hunting or fishing.

This excellent book would be an attractive addition to any angler's library.—*Chester Woodhull, California Division of Fish and Game.*

REPORTS

GAME CASES

July, August, September, 1948

Offense	Number arrests	Fines	Jail sentences (days)
Deer: Failure to tag; closed season; doe; spike buck; forked horn; spotted fawn; defacing deer tag; overlimit; in refuge; night hunting; "A" tag in 1 deer district; tag not validated; using another's tag; spotlighting; no deer tag	206	$17,250 00	35
Deer meat: Unstamped; closed season; sale; doe	33	3,195 00	
Doves: Late shooting; 22 rifle; from motor vehicle; overlimit; closed season	90	2,918 00	
Ducks: Closed season; purchase; overlimit	11	850 00	
Bear: Closed season	3	100 00	
Grouse: Possession	5	150 00	
Sagehen: Possession	2	185 00	
Squirrel: Killing gray	5	275 00	
Quail: Closed season	15	525 00	
Rabbits: Closed season; night hunting	28	725 00	25
Pheasants: Closed season; hen; from motor vehicle	71	6,530 00	90
Pigeons: Trapping	1		
Nongame: Taking	3	75 00	
Shorebirds: Possession	2	75 00	
Elk meat: Possession	3	125 00	
Hunting: In refuge; late and early shooting; from motor vehicle; at night; 22 rifle	202	10,996 00	23
Totals	680	$13,974 00	~~185~~ 173

FISH CASES

July, August, September, 1948

Offense	Number arrests	Fines	Jail sentences (days)
Abalone: Undersize; overlimit	40	$1,062 00	
Angling: No license; set line; night fishing; game fish for bait; closed waters; near dam; illegal gear; using dip net; 3 attractor blades	441	7,308 00	10
Striped bass: Overlimit; undersize; set line; failure to show on demand; night fishing	161	4,995 00	50
Crappie: Overlimit	3	35 00	
Catfish: Overlimit; operating fish trap	3	1,040 00	
Clams: Overlimit; undersize; out of shell	119	3,011 00	
Chumming	15	545 00	
Commercial: No license; failure to deliver reports; illegal gill net; drag net less than 50 fathoms; fish wastage; closed area	100	2,455 00	
Crabs: Undersize	1	20 00	
Cockles: Overlimit; undersize	10	260 00	
Bluegill: Overlimit	14	385 00	
Barracuda: Undersize	1	25 00	
Frogs: Undersize	6	200 00	
Lobsters: Closed season; oversize	3	550 00	
Pollution: Oil; sawdust; bilge	7	930 00	
Salmon: Illegally taken; snagging	10	350 00	
Sardines: Undersize	32	1,320 00	
Trout: Overlimit; set line; snagging; 3 poles; closed stream; 3 attractor blades	78	2,722 00	
Steelhead: Closed season	1	50 00	
Licenses: Using another's; transfer; nonresident using resident; false statement to obtain	39	792 00	
Totals	1,084	$28,055 00	60

Court forfeitures:

Undersize sardines and mackerel, pounds seized	636,493
Moneys received	$15,212 53

SEIZURE OF FISH AND GAME

July, August, September, 1948

Fish:

Abalone	365
Abalone, pounds	2
Bass	930
Barracuda	6
Bluegill	990
Clams	2,901
Catfish, pounds	135
Cockles	2,471
Carp	39
Crappie	65
Crabs	8
Halibut	8
Frogs	8
Lobsters	12
Lobsters, pounds	3,645
Salmon	69
Trout, pounds	195
Trout	1,282
Steelhead	3
Rock bass	4
Sardines, pounds	636,493

Game:

Deer	120
Deer, pounds	490
Doves	761
Coots	9
Ducks	110
Bear	1
Bear, pounds	50
Pheasants	87
Pigeons	4
Quail	7
Sagehen	1
Grouse	2
Rabbits	29
Shorebirds	6
Nongame	2
Squirrels	3
Elk meat, jars	26

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Notice of Commission Meetings to Establish Season and Bag Limits

Notice is hereby given that the Fish and Game Commission shall meet on January 7 and 8, 1949, in the California State Building, Los Angeles, California, to receive recommendations from its own officers and employees, from public agencies, from organizations of private citizens, and from any interested party as to what, if any, orders should be made relating to fish, mollusks, crustaceans, amphibia and reptiles, or any species or variety thereof except no recommendations shall be received relating to the commercial taking of fish, mollusks, crustaceans, amphibia and reptiles or any species or variety thereof.

———————

Notice is hereby given that the Fish and Game Commission shall meet on January 28 and 29, 1949, in the State Building, San Francisco, to hear and consider any objections to its determinations and proposed orders in accordance with Section 15.2 of the Fish and Game Code, such determinations and orders resulting from hearing held on January 7 and 8, 1949.